2.4

Data Summary for the *Soil and Debris Areas Addendum to the RI/FS Work Plan*—1997 Sampling at North Landfill, South Landfill, and Scrap Yard

PREPARED FOR: Steve Shaw/RMC

PREPARED BY: Cindy Dahl/CH2M HILL-CVO
Julie Eakins/CH2M HILL-CVO

COPIES: Dave Dailer/CH2M HILL-PDX
Scott Dethloff/CH2M HILL-PDX
Doug Macauley/RMC
Davi Richards/CH2M HILL-CVO
Dennis Shelton/CH2M HILL-CVO
RMC File

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SECTION 1

Introduction

SECTION 1

Introduction

1.1 Scope and Organization

This document presents a summary of data collected in response to the data needs identified in the *Draft Soil and Debris Areas Addendum to the RI/FS Work Plan* (CH2M HILL, February 18, 1997) for the Reynolds Metals Company (RMC) facility in Troutdale, Oregon. It provides information for three of the ten soil and debris areas: north landfill, south landfill, and scrap yard. Locations of these areas are shown on Figure 1-1.

The Addendum and this data summary address only surface exposures; the effect on groundwater of constituents in the soil and debris areas is being evaluated in the sitewide groundwater program. The Addendum based its review of data needs on the following evaluation criteria:

- The evaluation of risk to human health and the environment from surface exposures
- A preliminary identification of applicable or relevant and appropriate requirements (ARARs)
- Completion of the conceptual model
- A preliminary identification of potential remedial actions

The Addendum concluded that two areas, north landfill and south landfill, required additional information for evaluation of the above four items. The identified information is included in this data summary, which also contains information collected to confirm previously reported information, or that was gathered during the sitewide groundwater investigation for the three soil and debris areas addressed herein.

The information contained in this data summary will be used and evaluated in supplemental reports (for example, remedial investigations, feasibility studies, and baseline risk assessments).

The following data for **north landfill** are presented in Section 2 of this data summary:

- Surface soil data required for the evaluation of risk from surface exposure pathways.
- Analytical data and observations made from one additional test pit excavated in a previously unsampled portion of the landfill. The cross sections for the landfill have been revised to include this new area, and to present geological information gathered during the sitewide groundwater investigation.
- Review of historical records of the Sandy and Columbia Rivers and information from the U.S. Army Corps of Engineers (COE) and the U.S. Geological Survey (USGS). This information will be used to evaluate flood potential.

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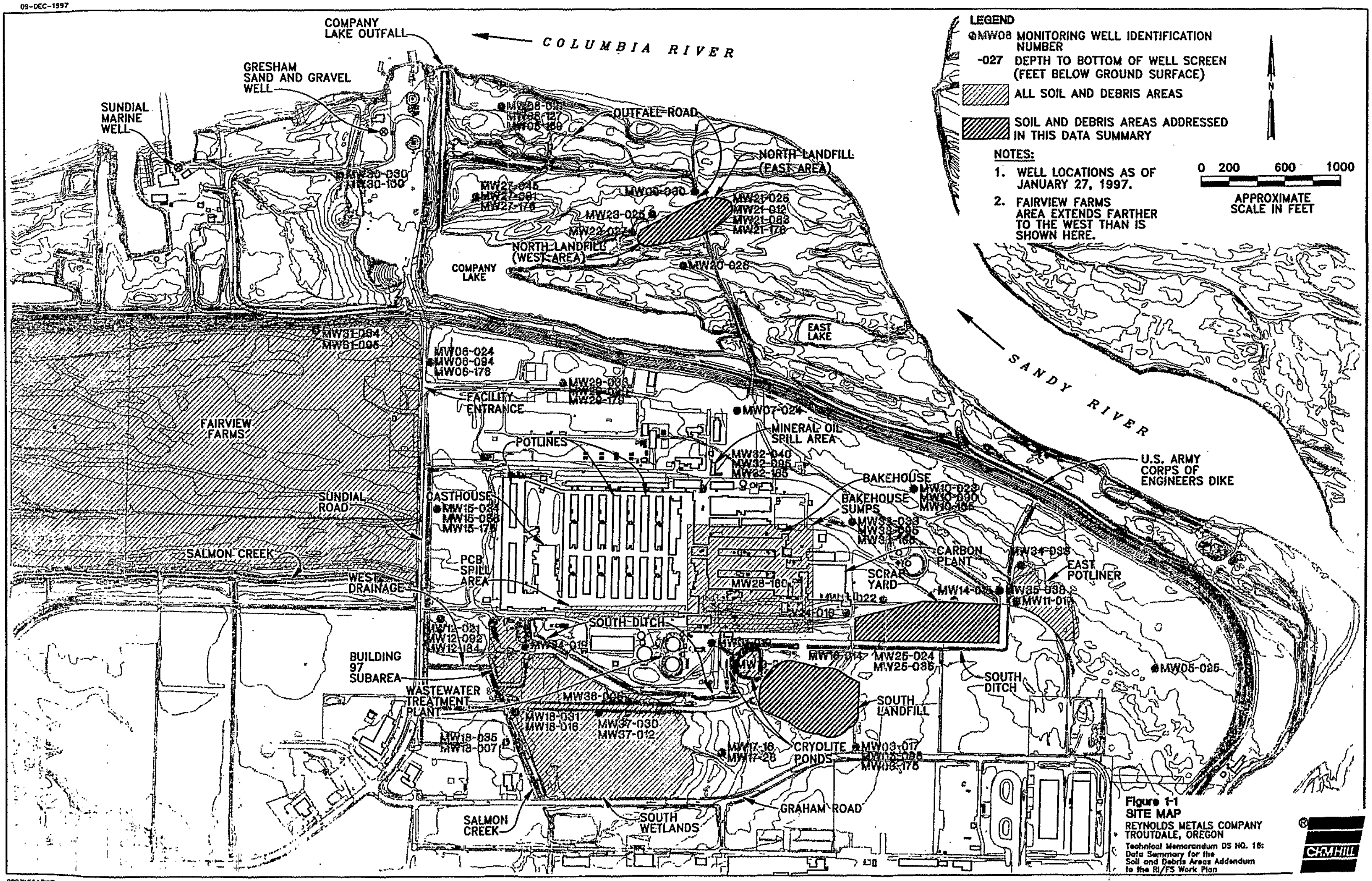

Figure 1-1
SITE MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS NO. 16:
Data Summary for the
Soil and Debris Areas Addendum
to the RI/FS Work Plan

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The following data for **south landfill** are presented in Section 3 of this data summary:

- Surface soil data required for the evaluation of risk from surface exposure pathways.
- Analytical data for two samples collected from seasonal standing water in the swale south of the south landfill. This information will be used for the evaluation of risk from surface exposure, and for the evaluation of groundwater and surface runoff transport pathways.
- The cross sections for the landfill have been revised to present geological information gathered during the sitewide groundwater investigation.

The following data for the **scrap yard** are presented in Section 4 of this data summary:

- Surface soil data collected to confirm polychlorinated biphenyl (PCB) data gathered during the July 1995 supplemental data-gathering investigation. The laboratory method used for the 1995 analysis of PCBs yielded data of questionable usability for concentrations above 10 milligrams per kilogram (mg/kg). Resampling and analysis were needed to verify the results of the surface exposure risk evaluation in the Addendum.
- The cross sections for the scrap yard have been revised to present geological information gathered during the sitewide groundwater investigation.

1.2 Status of the Soil and Debris Areas

The current status of the ten soil and debris areas identified at the Troutdale facility is summarized below. The remainder of this data summary addresses only the three areas for which additional data were collected.

1.2.1 North Landfill

The Addendum concluded that additional data were needed for the north landfill area. The additional data have been gathered and are provided in this data summary.

Attachment A contains exposure assumptions and risk calculations for the north landfill.

1.2.2 South Landfill

The Addendum concluded that additional data were needed for the south landfill area. The additional data have been gathered and are provided in this data summary.

Attachment B contains exposure assumptions and risk calculations for the south landfill.

1.2.3 Scrap Yard

The surface exposure risk evaluation of the scrap yard was presented in the Addendum. The risk evaluation resulted in the following conclusions:

- The previous data collected were sufficiently representative to complete the evaluation.
- Risks to human populations potentially exposed to scrap yard soil are below target risk levels generally considered by the U.S. Environmental Protection Agency (EPA) to

require remediation (10^{-4} excess cancer risk, hazard index greater than 1) (EPA, April 22, 1991).

- Risks to human populations potentially exposed to scrap yard soil exceed Oregon Environmental Cleanup Law acceptable human health excess cancer risk levels (10^{-5} cumulative excess cancer risk; 10^{-6} individual carcinogen excess cancer risk; hazard index greater than 1).

The surface exposure risk evaluation was based on surface soil analytical results gathered in July 1995. After the Addendum was prepared, it was determined that the analytical method that was used for PCBs differed from EPA standard methodology and that the reported results may be of questionable quality for PCB concentrations above 10 mg/kg. Therefore, resampling and analysis of surface soil were identified as a data need for the scrap yard to confirm the PCB concentrations in surface soil used in the risk evaluation. Sample collection, analytical data, and data analysis are presented in Section 4 of this data summary.

1.2.4 Fairview Farms

The surface exposure risk evaluation of Fairview Farms was presented in the Addendum. The risk evaluation resulted in the following conclusions:

- Surface soils present an acceptable level of surface exposure risk to humans and ecological receptors under the most likely future occupational use scenario.
- A preliminary review of potential ARARs did not identify a need for remedial action.
- No further data needs or requirements were identified relating to surface exposures.

The Fairview Farms area is not addressed in this data summary.

1.2.5 Mineral Oil Spill Area

The surface exposure risk evaluation of the mineral oil spill area was presented in the Addendum. The evaluation resulted in the following conclusions:

- Surface soils present an acceptable level of risk for reasonably anticipated future surface exposure pathways and land use.
- A preliminary review of potential ARARs did not identify a need for remedial action.
- No further data needs or requirements for evaluation were identified relating to surface exposures.

The mineral oil spill area is not addressed in this data summary.

1.2.6 East Potliner Area

The east potliner area was identified as a time-critical action (TCA) in *Removal Action Statement of Work No. 1* (EPA, March 1995). The action consisted of the excavation and offsite disposal of spent potliner (K088 waste) and contaminated soils from the east potliner area, in accordance with *Memorandum WP No. 7: Final East Potliner Area Work Plan for Removal Action* (CH2M HILL, October 11, 1995). The removal action activities occurred during 1995 and were completed in January 1996, as described in *Final Report: East Potliner Area Removal Action* (CH2M HILL, April 3, 1997).

The east potliner area is not addressed in this data summary.

1.2.7 South Wetlands

Although the south wetlands is identified as a soil and debris area, its remedial investigation/feasibility study (RI/FS) tasks have been documented separately from the other soil and debris areas. The data needs and risk evaluation were reviewed in the *Draft South Wetlands Addendum to the RI/FS Work Plan* (CH2M HILL, May 8, 1996) and in *Technical Memorandum DS No. 14: Data Summary for the South Wetlands Addendum to the RI/FS Work Plan, Part 1—Soil, Surface Water, and Groundwater Quality* (CH2M HILL, February 12, 1997).

At present, further data evaluation is being conducted at south wetlands to refine the risk estimates using site-specific information, and to evaluate the degree to which some of the constituents present are bioavailable. The results of this work will be presented in the upcoming Baseline Risk Assessment for South Wetlands Surface Exposures (CH2M HILL, to be prepared in 1998).

The south wetlands area is not addressed in this data summary.

1.2.8 Bakehouse Sumps

The bakehouse sumps area was identified as a TCA in *Removal Action Statement of Work No. 1* (EPA, March 1995). The action occurred in three phases. Phase 1 involved the removal and abandonment of 57 dewatering well points in and around the bakehouse in accordance with *Memorandum WP No. 17: Bakehouse Sumps Area Removal Action Work Plan, Phase 1—Well Point Abandonment* (CH2M HILL, May 30, 1996). Phase 2 involved removing and disposing of contaminated sediments from sumps, rerouting storm drainage from the sumps, rehabilitating several of the sumps, and modifying surface containment to prevent infiltration into sumps in accordance with *Memorandum WP No. 18: Draft Bakehouse Sumps Area Removal Action Work Plan, Phase 2—Bakehouse Sumps Removal Action* (CH2M HILL, May 30, 1996). Phase 3 consisted of rerouting drainage from the wet electrostatic precipitator (ESP) condensate drains to the plant's industrial wastewater treatment system, rerouting surface drainage, and decommissioning Bakehouse Sump No. 1.

Phase 1 removal action activities occurred in June 1996 and are documented in *Bakehouse Sumps Area Removal Action Report, Phase 1—Well Point Abandonment* (CH2M HILL, December 13, 1996). Phase 2 removal action activities occurred between November 1996 and January 1997. Phase 3 removal action activities occurred between May and November 1997. All three phases will be documented in the upcoming Bakehouse Sumps Area Removal Action Report (CH2M HILL, in progress).

The bakehouse sumps area is not addressed in this data summary.

1.2.9 Cryolite Ponds

The cryolite ponds area was identified as a TCA in *Removal Action Statement of Work No. 1* (EPA, March 1995). The action, which occurred between December 1994 and January 1996, consisted of the excavation and offsite disposal of cryolite and contaminated soils from one main pond in accordance with *Cryolite Removal Action Work Plan* (CH2M HILL, December 1994). Removal activities at the cryolite ponds are documented in *Final Report: Cryolite Pond Area Removal Action* (CH2M HILL, April 11, 1996).

The cryolite ponds area is not addressed in this data summary.

1.2.10 Casthouse/PCB Spill Area

The casthouse/PCB spill area was identified as a TCA in *Removal Action Statement of Work No. 1* (EPA, March 1995). The action involved the characterization and removal of contaminated dust, concrete, and siding from inside the casthouse, and the characterization, excavation, and disposal of PCB-contaminated soil from a spill area outside and just south of the casthouse in accordance with *Memorandum WP No. 10: PCB Spill Area Removal Action Work Plan* (CH2M HILL, May 30, 1996) and *Memorandum WP No. 21: Draft Casthouse Interior Removal Action Work Plan* (CH2M HILL, February 20, 1996).

Removal activities occurred between July 1996 and April 1997 and will be documented in the PCB Spill Area Removal Action Report (CH2M HILL, in progress).

The casthouse/PCB spill area is not addressed in this data summary.

SECTION 2

North Landfill

SECTION 2

North Landfill

2.1 Background

The north landfill is located in a wooded area in the northernmost portion of the RMC property (see Figure 1-1). It is located to the north of the COE flood protection dike, and most of the landfill lies within the 10-year floodplain of the Columbia River. The north landfill was active from about 1968 to about 1985 and was used for the disposal of a variety of waste, including carbon waste, refractory brick, and miscellaneous debris. The surface area of the landfill is approximately 2.7 acres. The maximum thickness of waste in north landfill is estimated to be 15 feet. Previous investigations within north landfill excavated test pits to 15 feet below the ground surface (bgs) but did not identify the bottom of the landfill. Seasonally, the bottom of the landfill may be below the water table elevation, which was estimated to be 7 to 12 feet bgs in January 1997. The outfall road from the RMC parking lot to Sundial Beach on the Columbia River crosses over the top of the landfill. A fence has been constructed along outfall road in the vicinity of the north landfill to discourage trespassers from entering the landfill area.

Three information-gathering efforts have been completed at north landfill to satisfy the data needs identified in the Addendum. A review of historical information about the Columbia and Sandy Rivers was completed to evaluate the potential for flooding of the north landfill. Surface soil samples were collected at north landfill to estimate the potential for direct contact exposures and evaluate risk from the surface exposure pathway. In addition, a test pit was excavated in an area of the landfill that had not previously been estimate the potential for direct and subsurface soil samples were collected. This section presents the results of these information-gathering efforts. In addition, this section provides a limited evaluation of the information, as well as updated cross sections for the north landfill area.

2.2 Sandy and Columbia Rivers Historical Information Review

One of the data needs identified in the Addendum related to the probability and extent of potential flooding of the north landfill. To understand the potential for a flood event to cause release of landfill contents to the river, one must have some information about the likelihood of such an event. To that end, this section evaluates flood potential by providing a review of historical records of the Sandy and Columbia Rivers, as well as information from the COE and the USGS. This information will be used in a feasibility study to evaluate how flow in the Columbia and Sandy Rivers will affect selection of remedial action(s) for north landfill.

The information compiled has three components:

- A presentation of COE water surface profile modeling results
- A review of historical USGS maps of the vicinity of the RMC facility
- A presentation of USGS information for the Columbia and Sandy Rivers

2.2.1 COE Water Surface Profile Modeling Results

The north landfill area is located within the Columbia River floodplain at an elevation of approximately 27 feet above mean sea level (MSL), near the confluence of the Columbia and Sandy Rivers. The COE flood control dike was originally constructed (in 1915) to contain a 100-year flood on the Columbia River (COE, December 30, 1953). The top of the dike in the vicinity of the north landfill is approximately 44 feet above MSL. The dike has been reinforced and improved during two major efforts (1940-41, 1953-54) since its construction. Recent COE models indicate that a 500-year flood elevation would be approximately 35 feet above MSL.

The COE has modeled reaches along the Columbia River by using the HEC-2 water surface profiles model. This model, developed and maintained by the COE's Hydrologic Engineering Center, predicts water surface elevations that correspond to peak flows of varying recurrence intervals. The COE's 1991 HEC-2 modeling results for the reach of the Columbia River adjacent to the RMC property were reviewed by CH2M HILL and evaluated for potential flooding impacts to Company Lake, which is located within the Columbia River floodplain, about 1,000 feet southwest of north landfill. This evaluation is discussed in *Technical Memorandum DS No. 15: Company Lake Supplemental Data Summary* (CH2M HILL, March 26, 1997). A summary of this evaluation, and its relevance for the north landfill site, is provided below.

Model results of interest include water surface elevations (stage) and velocities. Table 2-1 presents the HEC-2 model predicted water surface elevations and left overbank velocities (velocities south of the main river channel) for the Columbia River in the vicinity of the north landfill for the 2-, 10-, 50-, 100-, and 500-year flood recurrence intervals..

Table 2-1
COE HEC-2 Modeling Results for the Columbia River

Flood Recurrence Interval	Water Surface Elevations (feet above MSL)[a]	Left Overbank Velocities (feet per second)[b]
2-Year	21	0.2
10-Year	26	0.7
50-Year	30	1.0
100-Year	31	1.1
500-Year	35	1.3

[a] Elevations are rounded to the nearest foot.
[b] Velocities are rounded to the nearest 0.1 foot per second.

The velocities estimated for each flood level represent average velocities over a broad area and are based on average ground elevations and flow volumes. Localized topographic features serve to either accelerate or slow down water velocities. In the immediate vicinity of north landfill, the heavy vegetation and number of trees may be expected to reduce flood velocities during a short-term flooding event.

2.2.2 Historical Map Review

Maps of the area showing the positions of the Sandy and Columbia Rivers over the past 70 years were reviewed to evaluate changes in flow patterns of the lower reaches of the Sandy River. The following maps were reviewed and are included in Attachment C:

- USGS Topographic Map, Troutdale Quadrangle, dated July 30, 1918
- USGS Topographic Map, Camas Quadrangle, revised 1937
- USGS Topographic Map, Camas Quadrangle, revised 1954
- USGS Topographic Map, Camas and Washougal Quadrangles, revised 1975
- National Oceanic and Atmospheric Administration (NOAA) Nautical Map for the Columbia River, dated February 1994

Review of the above maps indicates that the shape and path of the Sandy River near the confluence with the Columbia River changed between 1937 and 1954. The 1937 map shows that the main flow of the Sandy River turns to the northeast in the vicinity of the Troutdale airport and discharges to the Columbia River in the direction of Gary Island. The 1954 map shows that the main flow of the Sandy River is in a north-northwest direction that does not change in the vicinity of the Troutdale airport and that the Sandy River discharges to the Columbia River in the direction of Lady Island, about 2 miles west of the point of discharge on the 1937 map. The 1954, 1975, and 1994 maps all show the Sandy River in approximately the same location, indicating that it did not change course significantly between 1954 and 1994. According to the USGS, the change between 1937 and 1954 may have been influenced by construction of dams on the Columbia during that time and subsequent regulation of Columbia River flows downstream, and by highway and bridge construction activities over the Sandy River east of Troutdale. The eastern branch of the Sandy was apparently dammed sometime after the river changed course. A dam is labeled on the 1994 map. Earlier maps (1954 through 1975) show what appears to be a manmade structure, but it is not identified.

The change in the position of the Sandy River is of some concern because of the possibility of a future channel migration to the west in the lower reach of the river. However, dams on the Columbia River moderate flow in all but extreme conditions. Currently, the north landfill is approximately 1,000 feet west of the Sandy River.

2.2.3 USGS Information

The USGS monitors the Interstate 84 (I-84) bridge over the Sandy River about 1 mile south of the site, as part of its bridge scour project. Observations made as part of this monitoring program, during the past 4 to 5 years, have identified changes in the lower reaches of the Sandy River. Observations indicate that the geomorphology of the Sandy River reacts to conditions of the Columbia River. When flows on the Columbia River are high, the lower Sandy River is in backwater that pools upstream to a point south of the I-84 bridge (a stretch of over 1,000 feet of the lower Sandy River). During these periods, the delta experiences a building phase as sediment in the Sandy River is deposited with the reduced velocity through the backwater reach. Conversely, at lower stages on the Columbia River, the velocities of the Sandy River increase with increased channel gradient, and the flow begins downcutting and transporting sediment. If significant volumes of sediment were deposited during the building phase, the Sandy River flow may cut through the delta in a different direction as it proceeds in the direction of least resistance. This building up and cutting of sediment in the delta may explain changes in the channel location of the Sandy River at its confluence with the Columbia. COE dredging to maintain shipping lanes in the Columbia River may prevent significant buildup of sediments in the delta.

The USGS has noted that, before the I-84 bridges were built, the flow in the channel appeared to have been confined to the east side of the existing channel. Today, however, the flow is primarily confined to the west side of the existing channel, and there are several secondary channels that carry flow during varying river stages. This current flow route is persistent and has necessitated armoring the west side of the channel with riprap in a number of places over the reach from south of the I-84 bridge to about 0.25 mile above the confluence with the Columbia River.

2.3 1997 Landfill Sampling

2.3.1 Sample Collection Procedures

2.3.1.1 Surface Soil Transects

The purpose of collecting surface soil samples was to estimate potential exposures and risks from direct contact with the landfill surface. Because it is reasonable to assume that there is equal probability for exposure regardless of location within north landfill, the sampling strategy was designed to give a reliable estimate of integrated exposure across the landfill surface. The sampling strategy was to collect discrete surface soil samples along five north-south transects evenly spaced across the landfill. Within each transect, five evenly spaced samples were collected, and a portion of each was composited to generate a single sample per transect. Thus, the concentration data from each transect effectively represent five locations, and the aggregate data from all transects effectively represent 25 locations across the landfill. This sampling strategy provides adequate coverage to yield a reliable concentration for exposure and risk analysis. In addition, this sampling methodology provides information on the distribution of constituents across the landfill surface. The relative distribution of constituents may provide useful information for the evaluation of remedial actions.

Surface soil sampling at north landfill was conducted on June 16-18, 1997. The locations of the five transects, as well as the five sample locations along each transect, are shown on Figure 2-1. The ends of the transects were generally located at the north and south boundaries of the landfill (as the boundaries were understood to be at that time), and the individual samples along each transect were located to evenly space them along the length of the transect. Sample collection was performed in accordance with the *Draft Sampling and Analysis Plan* (SAP) (CH2M HILL, July 1997).

At each individual sample location, soil was collected from 0 to 6 inches bgs. If the sample location was vegetated, the vegetation was loosened, and soil from the surface and root zone was shaken loose and collected. One 16-ounce jar was filled at each location to represent the discrete sample. This sample was sent to the laboratory to be archived and frozen for future analysis, if necessary. One 8-ounce sample jar was also filled at each

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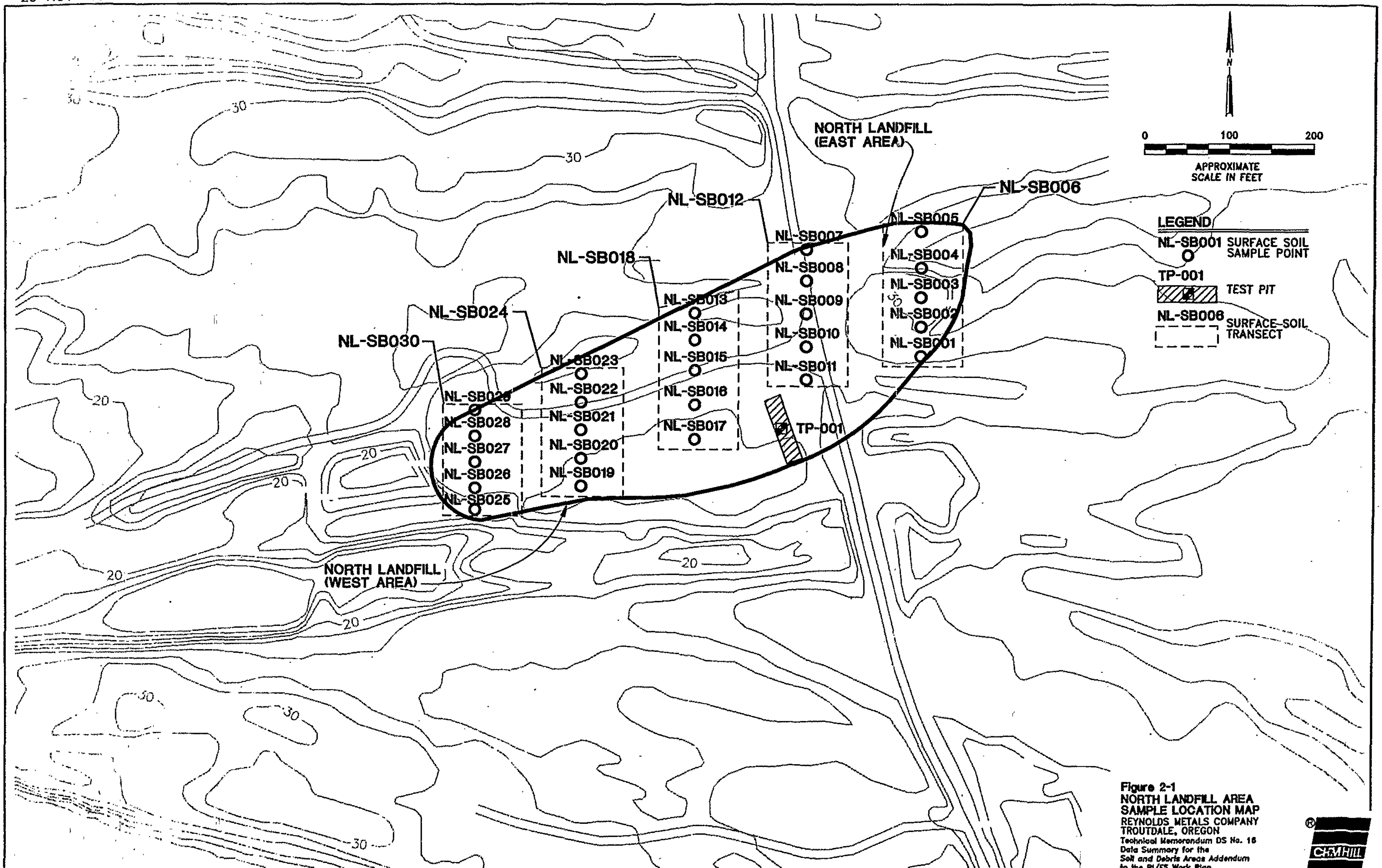

Figure 2-1
NORTH LANDFILL AREA
SAMPLE LOCATION MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16
Data Summary for the
Soil and Debris Areas Addendum
to the RI/FS Work Plan

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location. This procedure was completed at all five sample locations along a single transect. Equal volumes of soil from each sample location were then thoroughly composited. Three 8-ounce jars were then filled with composite sample for laboratory analysis.

Field quality assurance/quality control (QA/QC) consisted of collection of two duplicate soil samples to represent the 5 percent frequency required in the SAP (CH2M HILL, July 1997). One duplicate sample was a discrete sample, and one field duplicate sample was composite sample NL-SB018. No equipment blanks were collected because all equipment used in the sample collection was disposable.

Field observations during surface soil sampling at north landfill indicated that there were two primary soil types among the surface soil samples. One soil type was a medium brown silty loam. The other distinct soil type was a dark gray, stained silty loam, possibly discolored by waste material. Of these two different types of soil there were varying degrees of organic material, rocks/pebbles, and debris. Types of debris noted in the surface soil included whole bricks, brick particles, and wood debris.

The easternmost transect at north landfill had significantly different analytical results than did the other four north landfill transects (see Section 2.3.3.1). Individual discrete samples within this transect appeared to be non-native material, consisting of black silty loam.

2.3.1.2 Test Pit

During the removal site assessment (RSA) conducted in 1994, 17 test pits were excavated throughout north landfill to investigate the limits and interior of the area. During the 1997 investigation, one additional test pit was excavated in the south-central portion of the landfill (see Figure 2-1). This area was not originally identified as part of the landfill and was not investigated during the RSA. The purpose of excavating this additional test pit was to determine whether the south-central portion of the landfill is similar in content to the rest of the landfill.

The test pit was excavated on August 29, 1997. It was excavated as a trench oriented parallel to the outfall road (roughly north-south), with a length of approximately 80 feet and a width of approximately 3 feet. The center of the trench was approximately 50 feet west of the fence bordering the outfall road. The trench was excavated with a Case 580k backhoe to native fill, which was encountered at between 1 and 4 feet bgs.

Three discrete subsurface samples were collected from the wall of the excavation, at a location approximately midpoint (north-south) in the trench. The samples were collected at three depths in the trench at that location: at maximum depth (3 feet bgs), mid-depth (1.5 feet bgs), and near the surface. In addition, an equal amount of soil from each of the three sample depths was mixed to create a composite sample, which was submitted for analysis. The discrete samples were sent to the laboratory to be frozen as archive samples.

Field observations during excavation of the test pit indicated that waste material exists throughout the entire 80-foot length of the trench and, presumably, beyond it. At the northern edge of the trench, the depth of waste is approximately 1 foot bgs. Following the trench south from this point, the depth of waste increases to approximately 4 feet bgs at a point approximately midway along the length of the trench. Following the trench south from this point, the depth of waste decreases to approximately 1 foot bgs at a point approximately 80 feet south of the northern edge of the trench. The inferred boundary of the landfill, shown in Figure 2-1, has been modified from that shown in the Addendum to incorporate this information.

Waste material observed in the trench consisted primarily of brick. Other types of material observed included large pieces of metal scrap (including a refrigerator and a furnace lining), concrete, carbon, wood, plastic, and siding.

2.3.2 Laboratory Methods

Quality Analytical Laboratories (QAL) analyzed surface and subsurface soil samples collected from north landfill for polynuclear aromatic hydrocarbons (PAHs), PCBs, metals, cyanide, and bioavailable fluoride [using the gastrointestinal (GI) extraction method]. Soil samples were analyzed for total and soluble fluoride by Oregon Analytical Laboratory (OAL). The analytical methods are listed in Table 2-2. More specific discussion of analytical procedures and corresponding QA/QC procedures is provided in the SAP (CH2M HILL, July 1997).

2.3.3 Analytical Results

The analytical data are presented below for the surface and subsurface soil samples collected at the north landfill.

2.3.3.1 Surface Soil—Composite Samples

The analytical results for the composite surface soil samples from north landfill are provided in Table 2-3. Provided below is a summary of results. The analytical results of the surface soil samples are evaluated for surface exposure risk in Section 2.4.1.

Fluoride. Fluoride was detected in all five surface soil samples from north landfill. Concentrations of total fluoride ranged from 400 J to 12,000 J mg/kg; concentrations of soluble fluoride ranged from 2.7 to 1,400 D mg/kg; and concentrations of fluoride by the GI extraction method ranged from less than the detection limit of 75 mg/kg to 3,639 mg/kg. The highest fluoride concentrations were found in samples NL-SB006 and NL-SB018. The lowest fluoride concentrations by all three methods were found in sample NL-SB024.

Cyanide. Cyanide was detected in four of the five surface soil samples from north landfill. The highest concentration of total cyanide (3.31 mg/kg) was found in sample NL-SB006.

Metals. Metals were detected in each of the five composite surface soil samples. Table 2-4 summarizes the concentrations of metals found in the composite surface soil samples from north landfill. With the exception of mercury, the concentrations of all metals were highest in sample NL-SB006.

Table 2-2
Analytical Methods for Surface and Subsurface Soil Samples at North Landfill

Parameter	Method
Fluoride, total	EPA Method 340.1/340.2
Fluoride, soluble	EPA Method 300.0
Fluoride, bioavailable	GI Extraction Method[a]
Cyanide	EPA Method 335.2 CLP-M
PAHs (speciated)[b]	EPA Modified Method 8270-SIM
PCBs (speciated)[c]	CLP
Total Metals	
Aluminum	CLP
Antimony	CLP
Arsenic	CLP
Barium	CLP
Beryllium	CLP
Cadmium	CLP
Chromium	CLP
Copper	CLP
Lead	CLP
Mercury	CLP
Nickel	CLP
Selenium	CLP
Silver	CLP
Thallium	CLP
Vanadium	CLP
Zinc	CLP

[a] GI Extraction Method for soil as described in *Memorandum WO No. 1: Work Order for QAL Analysis of RMC Soil and Water Samples in 1997* (CH2M HILL, March 12, 1997).

[b] Individual PAH parameters include naphthalene, 2-methylnaphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

[c] Individual aroclors include 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.

Table 2-3 Analytical Results, Composite Surface Soil Samples, North Landfill							
Report Class	Analyte	Units	NL-SB006 6/18/97	NL-SB012 6/18/97	NL-SB018 6/18/97	NL-SB024 6/18/97	NL-SB030 6/18/97
CONV	Fluoride By 300.0	mg/kg	1400 D	41	1000 D	2.7	43
CONV	Fluoride By 340.1/340.2	mg/kg	9100 [J]	1000 [J]	12000 [J]	400 [J]	1800 [J]
CONV	Fluoride, GI Extraction	mg/kg	3630	222	2470	75 U	261
CONV	Cyanide, Total	mg/kg	3.31	0.55 U	2.44	0.77	1.6
M-TOTAL	Aluminum	mg/kg	25600	10800	22700	9260	18400
M-TOTAL	Antimony	mg/kg	3.5	2.8 U	3.2 U	3.4 U	3.3 U
M-TOTAL	Arsenic	mg/kg	13	2.8	8.1	3.8	6.7
M-TOTAL	Barium	mg/kg	108 [J]	46.4 [J]	79.1 [J]	84.8 [J]	83.4 [J]
M-TOTAL	Beryllium	mg/kg	4.3 [J]	0.55 U[J]	1.7 [J]	.68 U[J]	1.4 [J]
M-TOTAL	Cadmium	mg/kg	2.5	0.72	1.6	0.95	2.1
M-TOTAL	Chromium	mg/kg	45.9	25.7	20.5	11	33.3
M-TOTAL	Copper	mg/kg	8440 [J]	127 [J]	427 [J]	43.8 [J]	1180 [J]
M-TOTAL	Lead	mg/kg	68.3 [J]	11.9 [J]	45.1 [J]	17.7 [J]	44.4 [J]
M-TOTAL	Mercury	mg/kg	0.08 U	0.3	0.09	0.08 U	0.3
M-TOTAL	Nickel	mg/kg	111	27.2	86.4	17.3	44.2
M-TOTAL	Selenium	mg/kg	2.6	1.1 U	1.3 U	1.4 U	1.3 U
M-TOTAL	Silver	mg/kg	1.4 U	1.1 U	1.3 U	1.4 U	1.3 U
M-TOTAL	Thallium	mg/kg	1.4 U	1.1 U	1.3 U	1.4 U	1.3 U
M-TOTAL	Vanadium	mg/kg	112	50.1	61.1	45.9	65.6
M-TOTAL	Zinc	mg/kg	146	40.7	81.3	82.2	102
BNA	2-Methylnaphthalene	mg/kg	45 U	1.5 U	1.3 U	0.45 U	0.87 U
BNA	Acenaphthene	mg/kg	16 J	0.3 J	0.21 J	0.055 J	0.87 U
BNA	Acenaphthylene	mg/kg	45 U	1.5 U	1.3 U	0.45 U	0.87 U
BNA	Anthracene	mg/kg	26 J	0.34 J	0.39 J	0.089 J	0.16 J
BNA	Benzo(a)Anthracene	mg/kg	170	3.3	3.1	0.76	2.4
BNA	Benzo(a)Pyrene	mg/kg	230	5.2	3.3	0.85	2.2
BNA	Benzo(b)Fluoranthene	mg/kg	220	6.1	7.7	1.9	4.8
BNA	Benzo(G,H,I)Perylene	mg/kg	99	2	0.83 J	0.064 J	0.61 J
BNA	Benzo(k)Fluoranthene	mg/kg	160	5.1	4.1	1.3	4.1
BNA	Chrysene	mg/kg	180	4	4.3	1.1	3.8
BNA	Dibenzo(a,h)Anthracene	mg/kg	46	1.3 J	.92 J	0.17 J	0.41 J
BNA	Fluoranthene	mg/kg	280	4.8	5	1	2.6
BNA	Fluorene	mg/kg	5.7 J	1.5 U	1.3 U	0.45 U	0.87 U
BNA	Indeno(1,2,3-Cd)Pyrene	mg/kg	130	3.3	2.2	0.32 J	1.1
BNA	Naphthalene	mg/kg	45 U	1.5 U	1.3 U	0.45 U	0.87 U
BNA	Phenanthrene	mg/kg	140	2.1	2	0.43 J	0.69 J
BNA	Pyrene	mg/kg	230	3.7	3.7	0.85	2.4
PEST/PCB	Aroclor 1016	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1221	mg/kg	9.2 U	7.4 U	1.7 U	1.8 U	1.8 U
PEST/PCB	Aroclor 1232	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1242	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1248	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1254	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1260	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1262	mg/kg	4.5 U	3.7 U	0.86 U	0.9 U	0.87 U
PEST/PCB	Aroclor 1268	mg/kg	4.5 U	3.7 U	2.9	0.9 U	1.2

J = The reported value is estimated, since it is below the method reporting limit for the analysis.
U = The compound was analyzed for but not detected.
D = Results reported at more than one dilution factor.

Table 2-4 Metals Concentrations in Surface Soil, North Landfill			
Metal	Maximum Concentration Detected (mg/kg)	Location of Maximum Detection	Detection Frequency
Aluminum	25600	SB006	5/5
Antimony	3.5	SB006	1/5
Arsenic	13	SB006	5/5
Barium	108 J	SB006	5/5
Beryllium	4.3 J	SB006	3/5
Cadmium	2.5	SB006	5/5
Chromium	45.9	SB006	5/5
Copper	8440 J	SB006	5/5
Lead	68.3 J	SB006	5/5
Mercury	0.3	SB030	3/5
Nickel	111	SB006	5/5
Selenium	2.6	SB006	1/5
Vanadium	112	SB006	5/5
Zinc	146	SB006	5/5
J = The reported value is estimated, since it is below the method reporting limit for the analysis.			

PAHs. PAHs were detected in all five composite surface soil samples at north landfill. Table 2-5 summarizes the concentrations of PAHs found in the surface soil samples at north landfill.

In each of the five samples, the frequency of detected PAH compounds was similar, with 12 to 14 compounds detected in each sample. The PAH compounds detected were acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. With the exception of acenaphthene and fluorene, each of these compounds was detected in all five surface soil samples.

Detected concentrations of PAHs ranged from 0.055 J mg/kg (acenaphthene in sample NL-SB024) to 280 mg/kg (fluoranthene in sample NL-SB 006). The highest concentrations of PAHs were found in sample NL-SB006; this sample is the easternmost transect at north landfill, located east of the outfall road. The concentrations of individual PAHs in this sample were approximately one to two orders of magnitude higher than in the other four composite samples.

Table 2-5 PAH Concentrations in Surface Soil, North Landfill			
Compound	Maximum Concentration (mg/kg)[a]	Minimum Concentration (mg/kg)[b]	Frequency of Detection
2-methylnaphthalene	ND	ND	0/5
Acenaphthene	16 J	0.055 J	4/5
Acenaphthylene	ND	ND	0/5
Anthracene	26 J	0.089 J	5/5
Benzo(a)anthracene [c]	170	0.76	5/5
Benzo(a)pyrene [c]	230	0.85	5/5
Benzo(b)fluoranthene [c]	220	1.9	5/5
Benzo(g,h,i)perylene	99	0.064 J	5/5
Benzo(k)fluoranthene [c]	160	1.3	5/5
Chrysene [c]	180	1.1	5/5
Dibenzo(a,h)anthracene [c]	46	0.17 J	5/5
Fluoranthene	280	1	5/5
Fluorene	5.7 J	ND	1/5
Indeno(1,2,3-cd)pyrene [c]	130	0.32 J	5/5
Naphthalene	ND	ND	0/5
Phenanthrene	140	0.43 J	5/5
Pyrene	230	0.85	5/5

[a] All maximum detected concentrations were found in sample NL-SB006.
[b] All minimum detected concentrations were found in sample NL-SB024.
[c] Indicates carcinogenic PAH.

ND = Not detected.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.

PCBs. PCBs were detected in two of the five composite surface soil samples from north landfill. The only PCB compound detected was Aroclor 1268, which was detected at concentrations of 1.2 and 2.9 mg/kg in samples NL-SB030 and NL-SB018, respectively. PCBs were not detected in the other three samples.

2.3.3.2 Surface Soil—Discrete Samples

As will be presented in Section 2.4.1, one transect (composite sample NL-SB006) from north landfill contributes the majority of the estimated risk posed by the entire landfill, with the primary risk contributors being PAHs. Also, as shown in Table 2-3, this sample had concentrations of PAHs that were one to two orders of magnitude higher than any of the other composite samples. Therefore, all five discrete samples (NL-SB001 through NL-SB005) that were composited to form sample NL-SB006 were analyzed for PAHs. The analytical results for PAHs in the individual samples are provided in Table 2-6, which also shows the PAH results from composite sample NL-SB006 for comparison. These analytical results are evaluated in Sections 2.4.1 and 2.4.2.

Table 2-6
PAH Concentrations in Discrete Samples from One Transect at North Landfill

PAH Compound (mg/kg)	NL-SB006 (composite sample)	NL-SB001	NL-SB002	NL-SB003	NL-SB004	NL-SB005
Naphthalene	45 U	0.88 U	99 U	85 U	2.9 J	0.44 U
2-Methylnaphthalene	45 U	0.88 U	99 U	85 U	21 U	0.44 U
Acenaphthylene	45 U	0.88 U	99 U	85 U	21 U	0.44 U
Acenaphthene	16 J	0.22 J	48 J	47 J	7 J	0.068 J
Fluorene	5.7 J	0.092 J	16 J	20 J	3.4 J	0.44 U
Phenanthrene	140	1.6	300	310	73	0.44
Anthracene	26 J	0.32 J	70 J	76 J	18 J	0.075 J
Fluoranthene	280	3.7	570	590	110	1
Pyrene	230	3.4	510	540	110	1
Benzo(a)anthracene	170	2.5	400	430	85	0.75
Chrysene	180	2.8	430	450	96	0.78
Benzo(b)fluoranthene	220	2.7	430	440	94	0.84
Benzo(k)fluoranthene	160	3.1	400	350	91	0.98
Benzo(a)pyrene	230	2.9	360	470	86	0.88
Indeno(1,2,3-cd)pyrene	130	1.8	240	240	59	0.55
Dibenz(a,h)anthracene	46	0.73 J	100	95	25	0.22 J
Benzo(g,h,i)perylene	99	2.1	230	230	56	0.56

U = The compound was analyzed for but not detected.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.

2.3.3.3 Test Pit

Table 2-7 provides the analytical results for the composite subsurface soil sample collected from the test pit in the south-central part of north landfill. A brief discussion of the results is provided below. In Section 2.4.3, the analytical results from the subsurface soil sample are compared with subsurface soil samples collected previously from other parts of north landfill.

Table 2-7 Analytical Results, Composite Subsurface Soil Sample, North Landfill			
Report Class	Analyte	Units	NL-TP001 8/29/97
CONV	Fluoride, by 300.D	mg/kg	500
CONV	Fluoride, GI Extraction	mg/kg	5090
CONV	Cyanide, Total	mg/kg	13.7
M-TOTAL	Aluminum	mg/kg	105000
M-TOTAL	Antimony	mg/kg	3 U
M-TOTAL	Arsenic	mg/kg	21.2
M-TOTAL	Barium	mg/kg	80.8
M-TOTAL	Beryllium	mg/kg	9.2
M-TOTAL	Cadmium	mg/kg	1.3
M-TOTAL	Chromium	mg/kg	51.9
M-TOTAL	Copper	mg/kg	203 E
M-TOTAL	Lead	mg/kg	123
M-TOTAL	Mercury	mg/kg	0.1
M-TOTAL	Nickel	mg/kg	364 E
M-TOTAL	Selenium	mg/kg	12.2 U
M-TOTAL	Silver	mg/kg	1.2 U
M-TOTAL	Thallium	mg/kg	1.2 U
M-TOTAL	Vanadium	mg/kg	247
M-TOTAL	Zinc	mg/kg	202
BNA	2-Methylnaphthalene	mg/kg	0.8 U
BNA	Acenaphthene	mg/kg	0.1 J
BNA	Acenaphthylene	mg/kg	0.8 U
BNA	Anthracene	mg/kg	0.36 J
BNA	Benzo(a)Anthracene	mg/kg	1.1
BNA	Benzo(a)Pyrene	mg/kg	0.86
BNA	Benzo(b)Fluoranthene	mg/kg	1.2 [J]
BNA	Benzo(g,h,i)Perylene	mg/kg	0.17 J
BNA	Benzo(k)Fluoranthene	mg/kg	0.88
BNA	Chrysene	mg/kg	1
BNA	Dibenzo(a,h)Anthracene	mg/kg	0.22 J
BNA	Fluoranthene	mg/kg	2.9
BNA	Fluorene	mg/kg	0.12 J
BNA	Indeno(1,2,3-Cd)Pyrene	mg/kg	0.5 J
BNA	Naphthalene	mg/kg	0.8 U
BNA	Phenanthrene	mg/kg	1.8
BNA	Pyrene	mg/kg	1.9
PEST/PCB	Aroclor 1016	mg/kg	0.8 U
PEST/PCB	Aroclor 1221	mg/kg	1.6 U
PEST/PCB	Aroclor 1232	mg/kg	0.8 U
PEST/PCB	Aroclor 1242	mg/kg	0.8 U
PEST/PCB	Aroclor 1248	mg/kg	0.8 U
PEST/PCB	Aroclor 1254	mg/kg	0.8 U
PEST/PCB	Aroclor 1260	mg/kg	0.89

Table 2-7 Analytical Results, Composite Subsurface Soil Sample, North Landfill			
Report Class	Analyte	Units	NL-TP001 8/29/97
PEST/PCB	Aroclor 1262	mg/kg	0.8 U
PEST/PCB	Aroclor 1268	mg/kg	0.8 U
U = The compound was analyzed for but not detected above the method detection limit. E = The reported value is estimated, since it exceeds the linear calibration range for the compound. J = The concentration detected is estimated, since it is below the method detection limit.			

Fluoride. Fluoride was detected in the test pit composite sample at a concentration of 5,090 mg/kg by the GI extraction method. Soluble fluoride was also detected in the test pit sample at a concentration of 690 mg/kg. The sample was not analyzed for total fluoride.

Cyanide. Total cyanide was detected in the test pit sample at a concentration of 13.7 mg/kg.

Metals. Twelve metals were found in the test pit soil sample above detection limits. Concentrations of detected metals ranged from 0.1 mg/kg (lead) to 105,000 mg/kg (aluminum).

PAHs. Fourteen different PAH compounds were detected in the test pit sample. The concentrations of detected PAH compounds ranged from 0.1 J mg/kg (acenaphthene) to 2.9 mg/kg (fluoranthene).

PCBs. One PCB compound (Aroclor 1260) was detected in the test pit composite sample at a concentration of 0.89 mg/kg.

2.3.4 Conceptual Model Refinement

As a refinement to the conceptual model at north landfill, revised cross sections are presented in Figures 2-2, 2-3, and 2-4. These cross sections have been revised from cross sections presented in the Addendum. They incorporate the information from the new test pit, as well as additional information made available by the ongoing groundwater investigation.

2.4 Data Evaluation

2.4.1 Completion of Risk Evaluation for Surface Exposures

2.4.1.1 North Landfill Risk Evaluation

On the basis of the surface soil analytical results in Sections 2.3.3.1 and 2.3.3.2, this section presents the results of the risk evaluation for potential surface exposures at north landfill. The procedures and approach used to estimate risks are described in the *Draft Human Health and Ecological Risk Assessment Addendum to the RI/FS Work Plan* (CH2M HILL, August 5, 1996). Conceptual exposure models for human and ecological receptors were described in the Addendum and are presented schematically in Figures 2-5 and 2-6.

11-DEC-1997

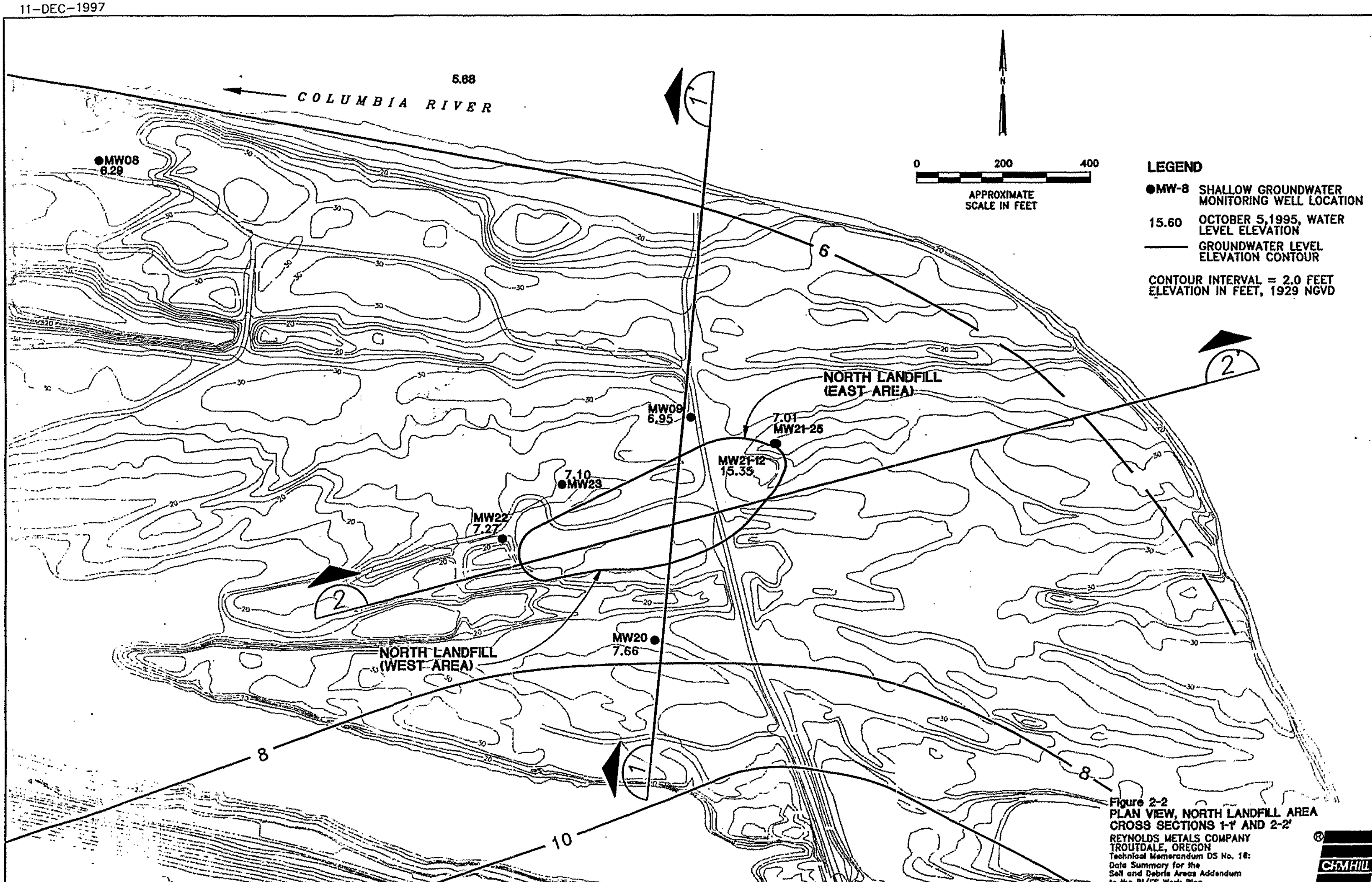

Figure 2-2
PLAN VIEW, NORTH LANDFILL AREA CROSS SECTIONS 1-1' AND 2-2'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 18: Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

CH2MHILL

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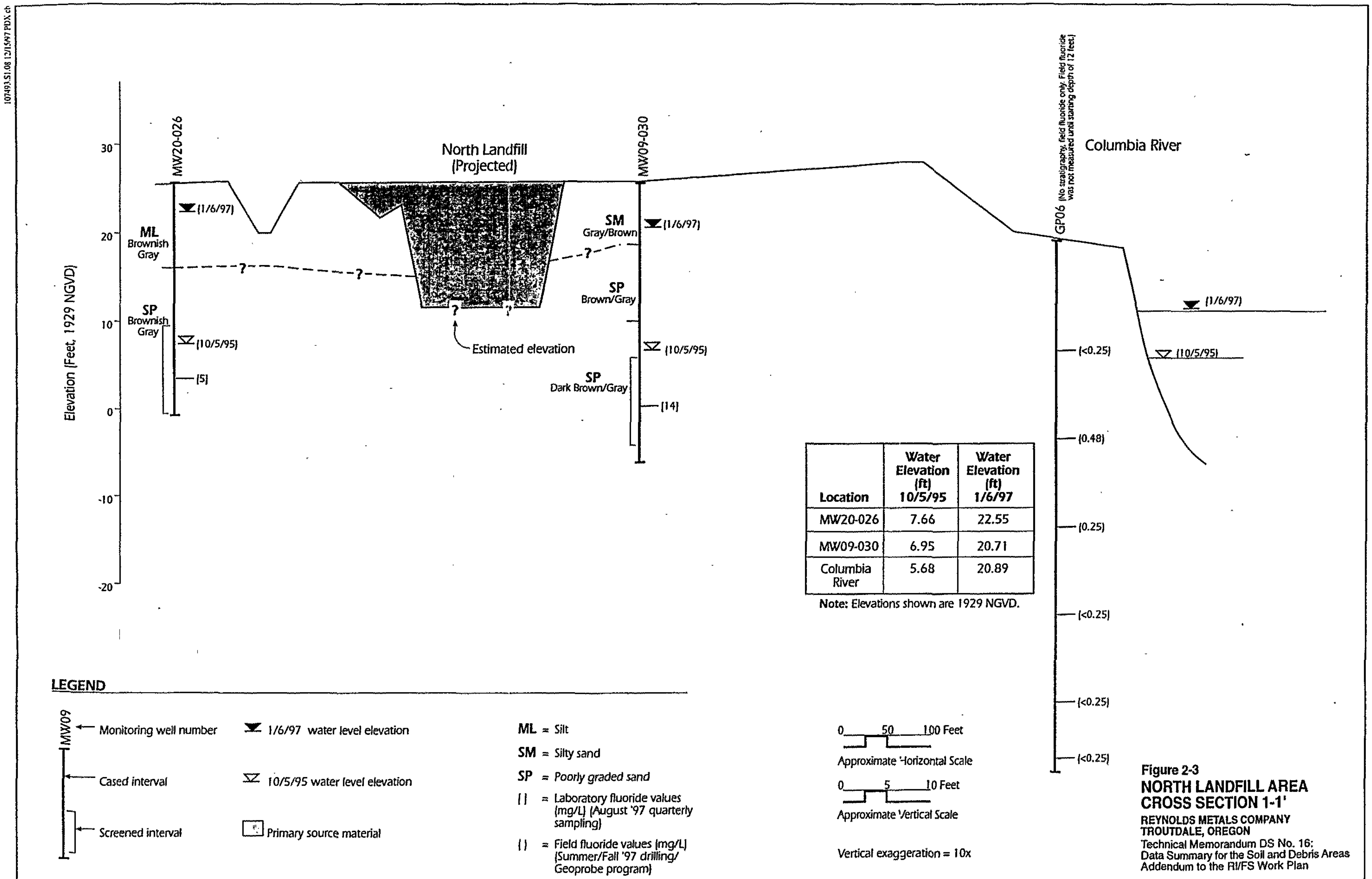

Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW20-026	7.66	22.55
MW09-030	6.95	20.71
Columbia River	5.68	20.89

Note: Elevations shown are 1929 NGVD.

Figure 2-3
NORTH LANDFILL AREA CROSS SECTION 1-1'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas
Addendum to the RI/FS Work Plan

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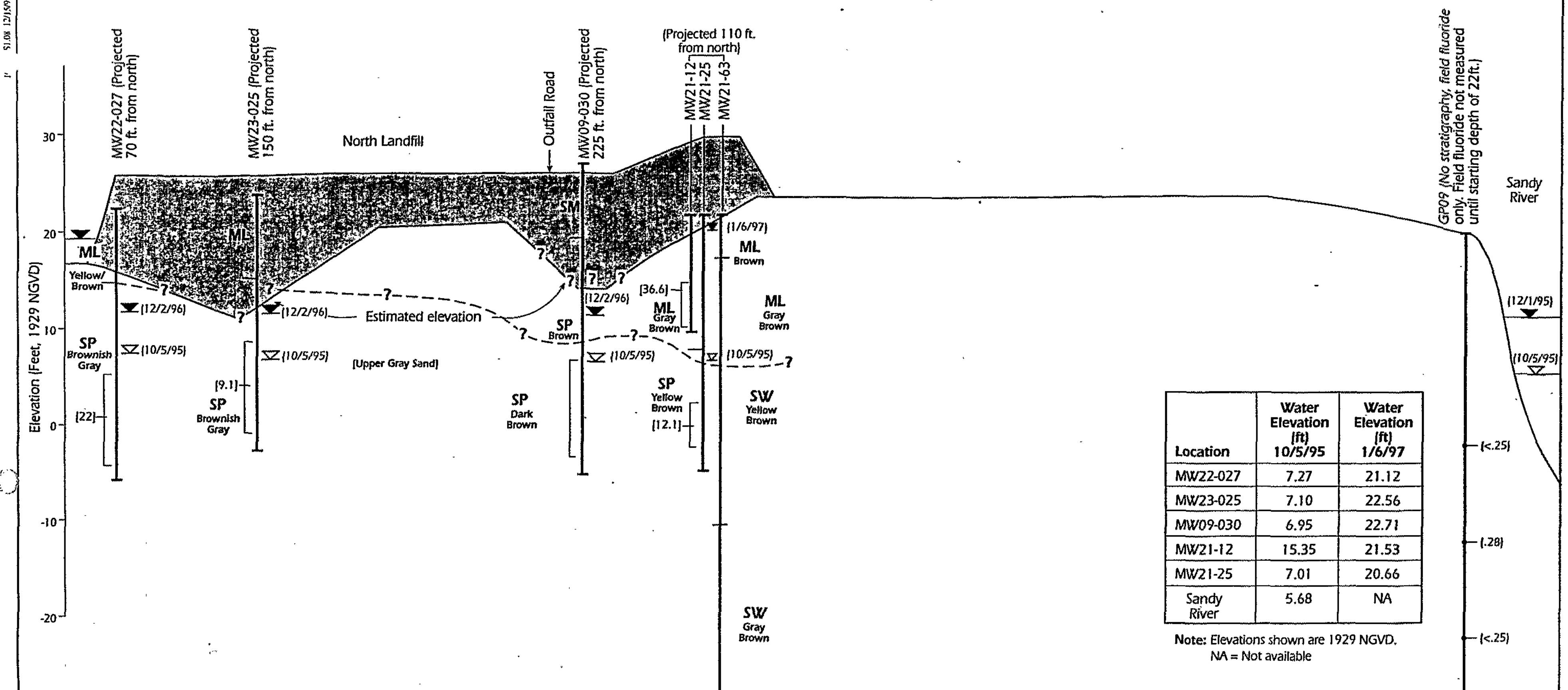

Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW22-027	7.27	21.12
MW23-025	7.10	22.56
MW09-030	6.95	22.71
MW21-12	15.35	21.53
MW21-25	7.01	20.66
Sandy River	5.68	NA

Note: Elevations shown are 1929 NGVD.
NA = Not available

LEGEND

- MW09 ← Monitoring well number
- ← Cased interval
- ← Screened interval
- 1/6/97 water level elevation
- 10/5/95 water level elevation
- Primary source material
- ML = Silt
- SM = Silty sand
- SP = Poorly graded sand
- SW = Well-graded sand
- [ ] = Laboratory fluoride values (mg/L) (August '97 quarterly sampling)
- ( ) = Field fluoride values (mg/L) (Summer/Fall '97 drilling/Geoprobe program)

0 50 100 Feet
Approximate Horizontal Scale

0 5 10 Feet
Approximate Vertical Scale

Vertical exaggeration = 10x

Figure 2-4
NORTH LANDFILL AREA CROSS SECTION 2-2'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas
Addendum to the RI/FS Work Plan

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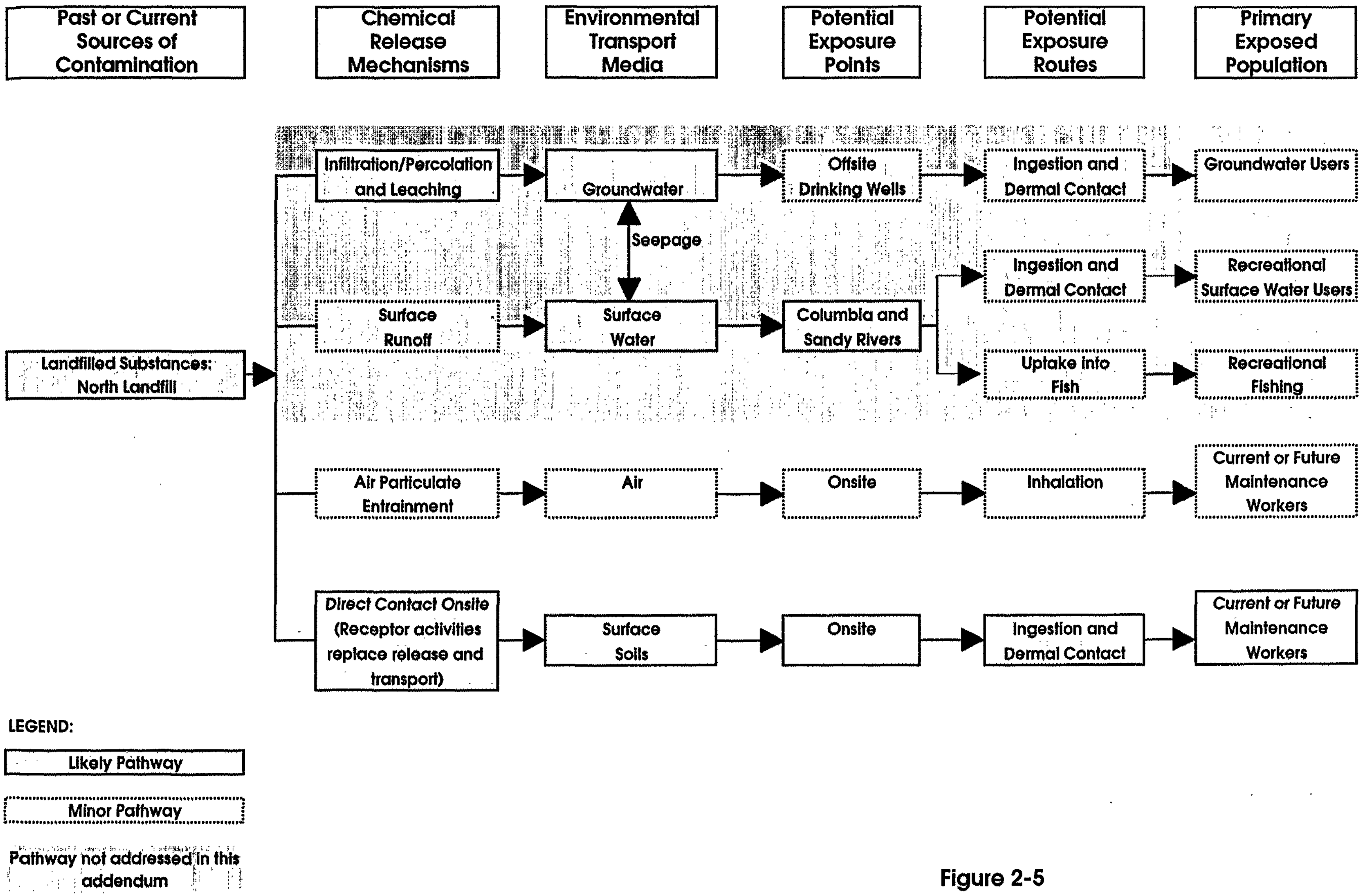

Figure 2-5
CONCEPTUAL MODEL FOR POTENTIAL HUMAN EXPOSURES AT NORTH LANDFILL
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

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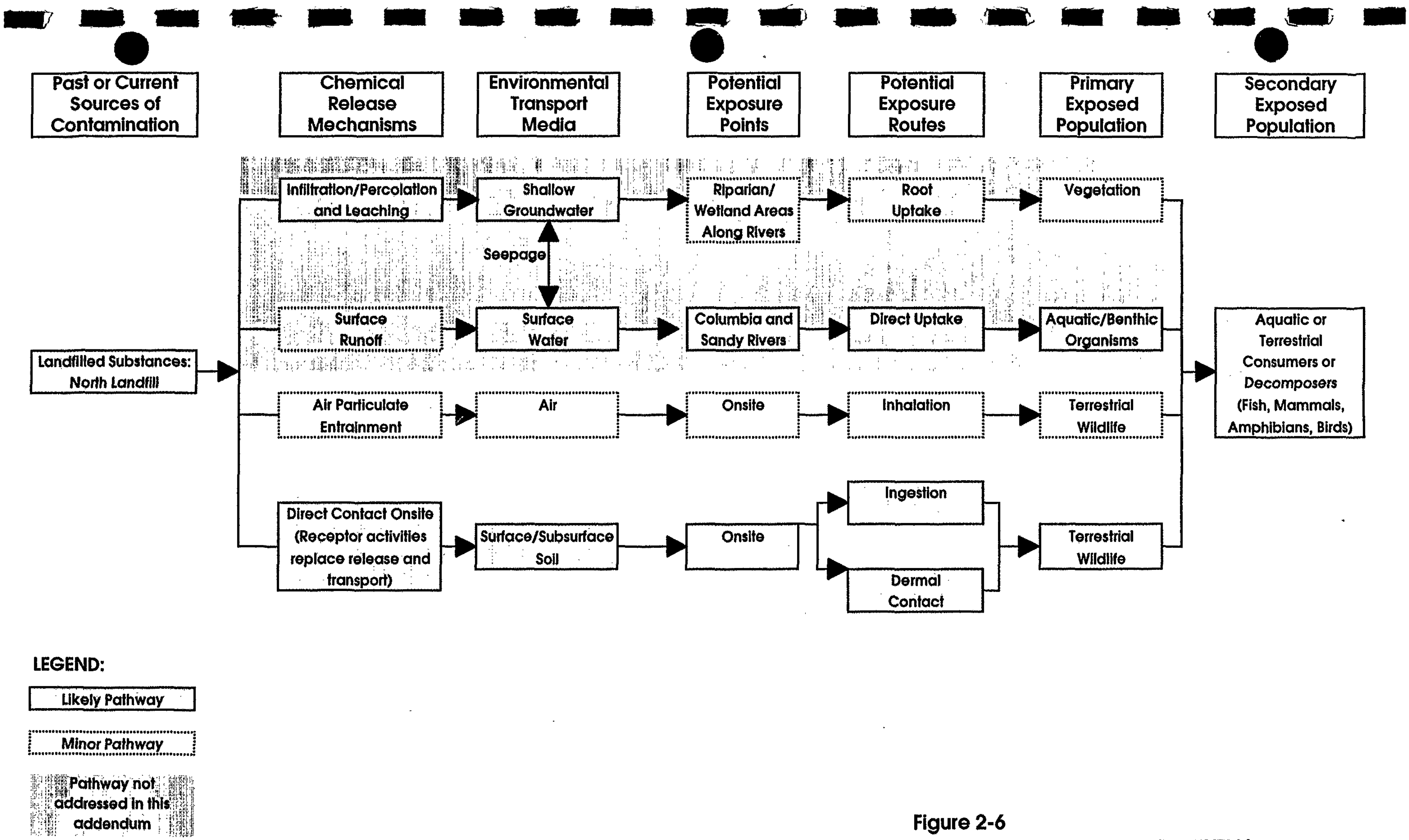

Figure 2-6
CONCEPTUAL MODEL FOR POTENTIAL ECOLOGICAL EXPOSURES AT NORTH LANDFILL
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

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2.4.1.2 Data Representativeness

A preliminary evaluation of data representativeness for risk assessment, presented in the Addendum, identified data needs to meet exposure and spatial representativeness. To address these data needs, the surface soil sampling program described in Section 2.3.1.1 provided adequate coverage to yield a reliable estimate of exposure across the landfill surface. Because the composite surface soil samples were collected from the depth where contact by maintenance workers and ecological receptors is most feasible (0 to 6 inches bgs), the data are considered to be representative with respect to exposure.

For the purposes of the risk evaluation for surface exposures, the areal extent of exposure for intermittent maintenance workers and ecological receptors was assumed to be the whole area of north landfill. The transects were spaced evenly across the expected area of exposure. The data are considered spatially representative for potential human and ecological exposures.

2.4.1.3 Risk Estimates

Potential Human Exposures to Soil. The primary exposure medium in the north landfill is surface soil containing site-related constituents. The most likely human receptors in the north landfill area are intermittent maintenance workers. Because of the north landfill's location within the floodplain, it is highly unlikely that the area will be used for any industrial purpose. However, a conservative assumption was made for the purpose of estimating risk. A 70-kg maintenance worker is assumed to frequent the north landfill area 26 days per year over 25 years of employment, inadvertently consuming 50 milligrams (mg) of soil per day. The noncancer and excess lifetime cancer risk estimates for intermittent maintenance workers are summarized in Table 2-8. The north landfill exposure assumptions and risk calculation data tables are provided in Attachment A.

Table 2-8
Summary of Risk Estimates for North Landfill Surface Soil

		Average Exposure		Reasonable Maximum Exposure	
Exposure Case	Exposure Scenario	Noncancer Hazard Index	Excess Lifetime Cancer Risk	Noncancer Hazard Index	Excess Lifetime Cancer Risk
North Landfill - Surface Soil All Transects	Intermittent Maintenance Worker	N/C[1]	5.2×10^{-6}	0.02	2.8×10^{-5}
North Landfill - Surface Soil Without SB006	Intermittent Maintenance Worker	N/C[1]	N/C[1]	N/C[2]	1.5×10^{-6}

N/C = Not calculated.
No COPCs in this category were detected.
[1]The average exposure scenario is not calculated when the reasonable maximum exposure scenario results in acceptable risk levels.
[2]The noncancer hazard index was not calculated, since inclusion of SB006 (high concentrations) in the data set did not result in unacceptable risk.

Exposure point concentrations were estimated by reviewing the maximum concentrations detected in the composite surface soil samples and the upper 95 percent confidence limit on the arithmetic mean of the samples for each constituent. The lower of the two concentrations was used as the exposure point concentration for risk quantification. The primary risk contributors in north landfill surface soil are PAHs, with benzo(a)pyrene contributing 68 percent of the total risk, at an estimated exposure point concentration of 145 mg/kg.

The aggregate reasonable maximum exposure (RME) risk estimates for the north landfill are below EPA's target risk levels of an excess cancer risk of 1×10^{-4} and a noncancer hazard index of 1.0. The RME risk estimates for surface soil at the north landfill exceed the DEQ acceptable human health excess cancer risk level of 1×10^{-5} for cumulative contaminant exposure, but they are below the DEQ acceptable human health hazard index of <1.0. Also, the individual chemical risk estimates for several PAHs exceed the DEQ acceptable human health excess cancer risk level of 1×10^{-6} for a single carcinogen.

As shown in Table 2-3, one of the transects in north landfill (NL-SB006) had concentrations of PAHs that were at least an order of magnitude higher than any of the other transects. Elevated concentrations in this one transect contribute the majority of the estimated risk posed by the entire exposure unit. In order to identify the influence of transect NL-SB006, the maximum detected concentrations from the remaining four transects were used to estimate direct contact risks for maintenance workers. Table 2-8 presents the results of this evaluation. If an action is taken in north landfill that removes exposure to the elevated PAH concentrations in transect NL-SB006, the residual excess lifetime cancer risk for maintenance workers would not be expected to exceed 2×10^{-6}. Thus, about 95 percent of the total north landfill risk is contributed by transect NL-SB006.

An uncertainty associated with these risk estimates is that only the ingestion exposure route was considered for PAHs. The dermal pathway is not quantified for PAHs in this preliminary risk assessment because of the uncertainties associated with risks from PAHs via this route. Toxicity values do not exist for the dermal route of exposure. While some PAHs are known to be toxic when applied dermally [for example, benzo(a)pyrene causes skin tumors], the use of dose-response information for orally exposed animals [for example, benzo(a)pyrene causes gastrointestinal tumors when ingested] could lead to erroneous conclusions because a dose-response relationship is likely to be different than for skin exposures. If dermal exposure to PAHs occurs, the potential risks could be higher than the estimates provided in Table 2-8.

Potential Ecological Exposures to Soil. Exposure point concentrations for surface soil from north landfill were compared with conservative ecological screening levels to identify chemicals of potential concern for terrestrial and avian receptors. Table A-8 (see Attachment A) summarizes the ecological screening evaluation. Aluminum, copper, and vanadium exceed the ecological screening levels. The bioavailability of these metals is being evaluated, and a refinement to this risk analysis that incorporates the bioavailable fraction as well as area use by wildlife will be presented, if necessary, in the sitewide baseline risk assessment.

2.4.1.4 Summary of the Preliminary Risk Evaluation

The preliminary risk evaluation results indicate that potential risks to human populations exposed to north landfill surface soil exceed DEQ acceptable excess cancer risk levels, but they are below EPA acceptable excess cancer risk levels. Some constituents have been identified as chemicals of potential ecological concern, and they require further evaluation.

2.4.2 Significance of Surface Soil Discrete Sample Results

At north landfill, the composite sample for one transect (NL-SB006) had elevated concentrations of PAHs that contributed significantly to risk estimates for the overall exposure unit. Therefore, the frozen discrete samples from that transect were analyzed to determine whether the entire transect had elevated concentrations or whether one sample was responsible for elevated concentrations in the composite sample.

Discrete samples along this one transect were analyzed for PAHs; results indicated that two of the five discrete samples had elevated concentrations of PAHs. (See Table 2-6.) The highest concentrations were in samples NL-SB002 and NL-SB003; these were two to three times higher than the composite sample concentrations. Because the two samples with elevated concentrations were adjacent, these data effectively narrow the area to be evaluated for potential remedial action for the purpose of reducing surface exposure risk.

2.4.3 Comparison with Previously Collected Data—Test Pit

The following paragraphs discuss the information collected from the new test pit and compare this information with previous subsurface information gathered from north landfill. Previous subsurface information was gathered from 17 test pits at north landfill that were excavated during the RSA in June and July 1994.

The new test pit was excavated during the 1997 sampling in order to investigate a portion of the landfill that had not previously been investigated. The test pit analytical results were not used in the risk evaluation because there are no risk scenarios for exposure to subsurface soils.

2.4.3.1 Lithologic Information and Waste Materials

The information obtained from the new test pit indicates that the boundaries of north landfill extend farther to the south than had previously been known. Cross sections of the site have been revised to include the additional lithologic information. Figures 2-2 through 2-4 are a plan view and updated cross sections of north landfill that reflect the current understanding of its stratigraphy.

Information from the new test pit indicates that the thickness of waste material in the south-central portion of the landfill is less than in other parts of the landfill. Native material was encountered in the new test pit at depths of between 1 and 4 feet bgs. The depth of waste materials in other parts of north landfill, as determined from previous test pit and monitoring well data, is estimated to be at least 15 feet.

The types of waste identified in the test pit (including brick material, metal, concrete, carbon, wood, and plastic waste) are similar in character to other buried waste materials that were found in test pits in other parts of north landfill.

2.4.3.2 Analytical Data

Below is a discussion of the analytical results of the new test pit subsurface soil sample (presented in Section 2.3.3.3) in comparison with other subsurface soil samples collected from north landfill during the RSA in June and July 1994.

Fluoride. The soluble fluoride concentration (500 mg/kg) in the subsurface soil sample from the new test pit is higher than soluble fluoride concentrations (17 to 490 mg/kg) in subsurface soil samples from seven test pits excavated west of the outfall road during the 1994 RSA. Although it was not requested, the test pit sample was also analyzed for fluoride by GI extraction because of miscommunication with the lab. This result cannot be compared with previous subsurface soil samples collected in north landfill because no previous soil samples were analyzed by this method.

Cyanide. The concentration of cyanide in the test pit sample (13.7 mg/kg) is one to two orders of magnitude higher than previous subsurface soil analytical results. Analytical results of total cyanide from seven test pits west of the outfall road and one test pit east of the outfall road ranged from 0.1 to 1.6 mg/kg.

Metals. Table 2-9 summarizes the metals concentration in the new test pit sample in comparison with previous metals concentrations in subsurface soil samples collected from north landfill. The concentrations of metals in the new test pit sample are higher than the historical maximum concentration for the following metals: arsenic, beryllium, chromium, lead, and nickel. Also, there are no historical data for aluminum, barium, or vanadium with which to compare the new metals results.

PAHs. The concentrations of PAHs in the new test pit sample are higher than in previous subsurface soil samples. However, only two other subsurface soil samples were collected from north landfill (from east of the outfall road) and analyzed for speciated PAHs. Seven samples were collected from test pits west of the outfall road, but these are not directly comparable because they were analyzed for total PAHs.

For some PAH compounds [for example, fluoranthene, phenanthrene, benzo(a)anthracene], the new test pit soil concentrations are 10 times higher than the previous samples that were analyzed for individual PAHs.

PCBs. The concentration of PCBs in the test pit subsurface soil sample (0.89 mg/kg Aroclor 1260) is similar to other subsurface samples collected from north landfill and tested for PCBs. Concentrations of Aroclor 1260 in 13 other samples collected from subsurface soil, most being discrete rather than composited samples, ranged from 0.068 mg/kg to 31 J mg/kg. The new test pit subsurface soil sample did not contain detectable concentrations of Aroclors 1248 and 1254, which were detected in other subsurface soil samples from north landfill.

Table 2-9
Comparison of Metal Concentrations in Subsurface Soil

Metal	New Test Pit Metal Concentration (mg/kg)	Previous Metal Concentrations[a]
Aluminum	105,000	NA
Antimony	ND	2.5 - 3.1
Arsenic	21.2	1.9 - 8.3
Barium	80.8	NA
Beryllium	9.2	1.0 - 2.7
Cadmium	1.3	1.0 - 1.5
Chromium	51.9	10.0 - 28.0
Copper	203 E	23.0 - 1300.0
Lead	123	16.0 - 76.0
Mercury	0.1	0.25
Nickel	364 E	9.2 - 55.0
Selenium	ND	1.0
Silver	ND	1.0
Thallium	ND	1.0
Vanadium	247	NA
Zinc	202	39.0 L - 180.0 L

[a] Based on seven subsurface soil samples from test pits west of the outfall road in July 1994.
ND = Not detected.
NA = Not analyzed.
E = The reported value is estimated, since it exceeds the linear calibration range for the compound.
L = The reported value is estimated; it may be biased low on the basis of spike recovery results.

SECTION 3
South Landfill

SECTION 3

South Landfill

3.1 Background

The south landfill is located south of the scrap yard and bakehouse, immediately south of the South Ditch (see Figure 1-1). The south landfill was used for general waste disposal between the 1940s and the late 1960s. However, the area continued to be used for temporary storage into the 1970s. Currently, drill cuttings produced during installation of monitoring wells on the RMC property (outside of known source areas) are being staged on the landfill. Approximately 250 tons of crushed steel slag material is stored near the landfill, underlain by plastic sheeting. Brick and debris removed from Fairview Farms are also staged at the landfill.

The surface area of south landfill is approximately 5.7 acres; the landfill is distinguished from the surrounding land by sparse vegetation and a surface cover of mixed soil and debris. The volume of waste present in south landfill is estimated to be approximately 21,000 cubic yards, with a maximum thickness of 6 to 7 feet. Groundwater elevation data indicate that when groundwater levels are high, up to 50 percent of the landfill waste materials in south landfill may be in contact with groundwater.

Two information-gathering efforts have been completed at south landfill to satisfy the data needs identified in the Addendum. Surface soil samples were collected to estimate the potential for direct-contact exposures and evaluate risk from the surface exposure pathway. Surface water samples were collected from the swale just south of south landfill. The surface water sample results will be used to evaluate risk from the surface exposure pathway. These results will also be used in the groundwater program to evaluate the potential source of the water: either surface runoff or shallow groundwater. This section presents the results of these information-gathering efforts. In addition, this section provides a limited evaluation of the information, as well as updated cross sections for the south landfill area.

3.2 1997 Landfill Sampling

3.2.1 Sample Collection Procedures

3.2.1.1 Surface Soil Transects

The purpose of collecting surface soil samples is to estimate potential exposures and risks from direct contact with the landfill surface. Because it is reasonable to assume that there is equal probability for exposure regardless of location within south landfill, the sampling strategy was designed to give a reliable estimate of integrated exposure across the landfill surface. The sampling strategy was to collect discrete surface soil samples along 10 north-south transects evenly spaced across the landfill. Within each transect, five evenly spaced surface soil samples were collected, and a portion of each was composited to generate a single sample per transect. Thus, the concentration data from each transect effectively represent five locations, and the aggregate data from all transects effectively represent 50 locations across the landfill. This sampling strategy provides adequate coverage to yield a reliable concentration for exposure and risk analysis. In addition, this sampling methodology provides information on the distribution of constituents across the landfill surface. The relative distribution of constituents may provide useful information for the evaluation of remedial actions.

Surface soil sampling at south landfill was conducted June 16-18, 1997. The locations of the 10 transects, as well as the five sample locations along each transect, are shown on Figure 3-1. The ends of the transects were generally located at the north and south boundaries of the landfill, and the individual samples along each transect were located to evenly space them along the length of the transect. Sample collection was performed in accordance with the SAP (CH2M HILL, July 1997).

At each individual sample location, soil was collected from 0 to 6 inches bgs. If the sample location was vegetated, the vegetation was loosened, and soil from the surface and root zone was shaken loose and collected. One 16-ounce jar was filled at each location to represent the discrete sample. This sample was sent to the laboratory to be archived and frozen for future analysis, if necessary. One 8-ounce sample jar was also filled at each location. This procedure was completed at all five sample locations along a single transect. Equal volumes of soil from each sample location were then thoroughly composited. Three 8-ounce jars were then filled with the composite sample material for laboratory analysis.

Field quality assurance/quality control (QA/QC) consisted of collection of three duplicate soil samples to represent the 5 percent frequency required in the SAP (CH2M HILL, July 1997). Two duplicate samples were discrete samples, and one of the field duplicate samples was composite sample SL-SB012. No equipment blanks were collected because all equipment used in the sample collection was disposable.

Field observations during surface soil sampling at south landfill indicated that surface soils at south landfill were visually similar to surface soils at north landfill, and generally there were two primary soil types. One soil type was a medium brown silty sand. The other distinct soil type was a dark gray silty sand. Of these two different types of soil, there were varying degrees of organic material, rocks/pebbles, and debris. Types of debris noted in the soil samples included brick and brick particles, broken glass, wood debris, and minor concrete and metal debris. Some samples contained a black granular carbon material.

3.2.1.2 Surface Water in the Swale

Surface water samples were collected from seasonal standing water that collects in a swale located immediately south of south landfill. The surface water samples were collected from one location (shown on Figure 3-1).

Samples of water from the swale were collected on two different occasions. One surface water sample was collected on April 28, 1997 (sample ID: SL-SW01), during a significant precipitation event that had started 2 days before sampling. This sample was collected to evaluate the potential that the swale contains surface runoff from the landfill. A second surface water sample was collected on May 9, 1997 (sample ID: SL-SW02), after a 4-day period of dry weather. This sample was collected to evaluate the potential that the swale contains shallow groundwater.

09-DEC-1997

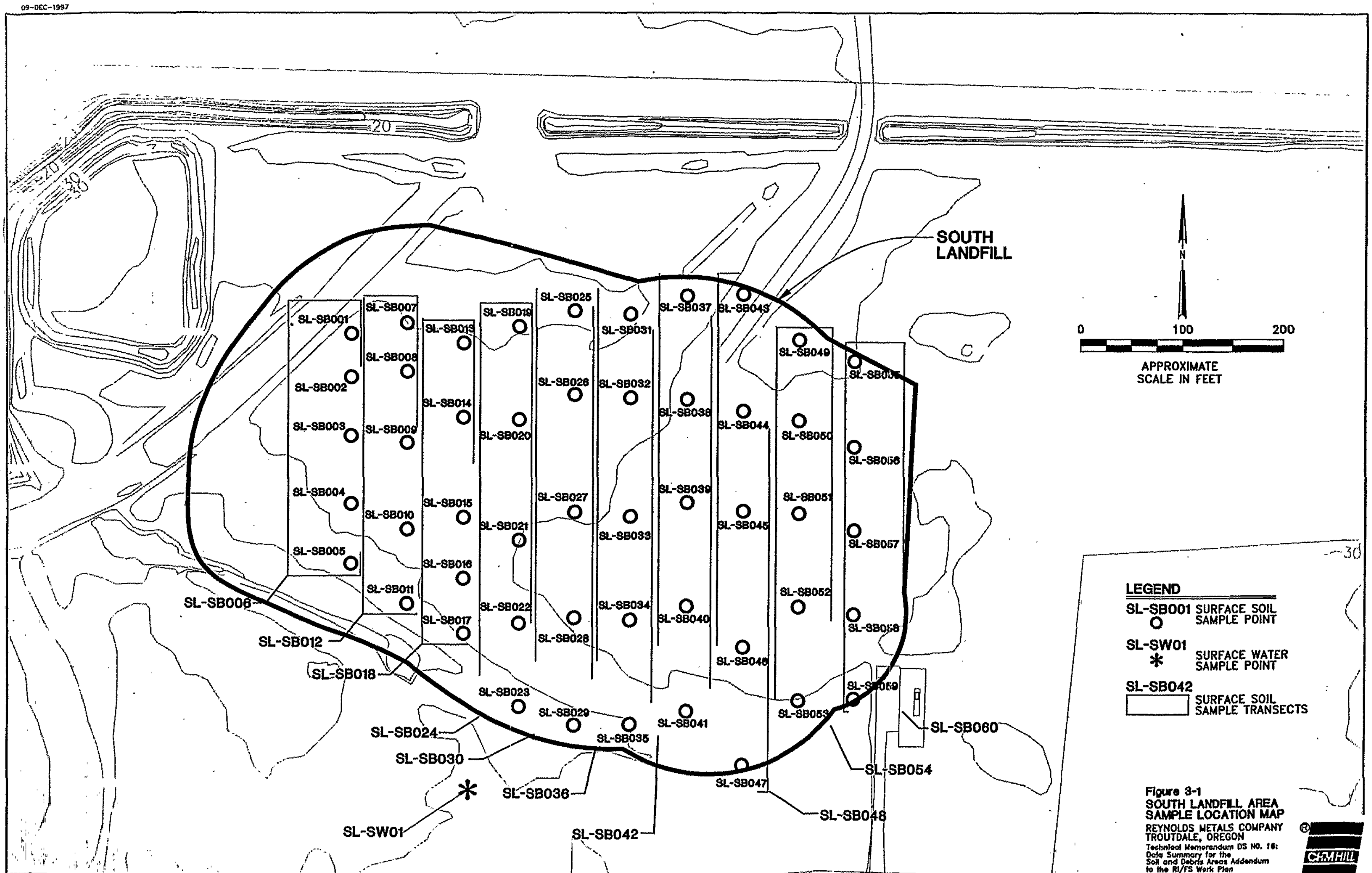

Figure 3-1
SOUTH LANDFILL AREA SAMPLE LOCATION MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS NO. 16: Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

9293FC24.DWG

Surface water samples were collected directly into the sample bottles. Water samples to be analyzed for dissolved metals were field filtered using a pressurized disposable bailer with a 0.45-micron attached filter.

During both surface water sampling events, the total depth of the water at the sample location was 1.5 to 2.0 feet. Field measurements of pH, temperature, and conductivity were taken and are shown in Table 3-1.

Table 3-1
Field Measurements for Surface Water Samples

Sample Date	Temperature (degrees C)	pH	Conductivity (µmhos/cm)
4/28/97	12.9	7.35	200
5/9/97	25	6.99	350

Field observations during both surface water sampling events noted large, stringy mats of a greenish, yellow algae or bacteria throughout the water column.

3.2.2 Laboratory Methods

3.2.2.1 Soil

QAL analyzed surface soil samples for PAHs, PCBs, metals, cyanide, and bioavailable fluoride (using the GI extraction method). OAL analyzed soil samples for total and soluble fluoride. The analytical methods are listed in Table 3-2. More specific discussion of analytical procedures and corresponding QA/QC procedures is provided in the SAP (CH2M HILL, July 1997).

3.2.2.2 Water

QAL analyzed surface water samples for PAHs, PCBs, metals, fluoride, cyanide (total), cyanide (amenable), and hardness. The analytical methods are listed in Table 3-2. More specific discussion of analytical procedures and corresponding QA/QC procedures is provided in the SAP (CH2M HILL, July 1997).

3.2.3 Analytical Results

The analytical data are presented below for the surface soil and surface water samples collected at the south landfill.

3.2.3.1 Surface Soil

Analytical results for the composite surface soil samples from south landfill are provided in Table 3-3. Provided below is a summary of results. Unlike north landfill, no discrete surface soil samples were analyzed for south landfill. A review of composite sample data for south landfill indicated that one sample (SL-SB012) had elevated concentrations of several constituents relative to the other composite samples. However, a preliminary comparison

Table 3-2 Analytical Methods for Surface Soil and Surface Water Samples at South Landfill		
	Surface Soil	**Surface Water**
Parameter	**Method**	**Method**
Fluoride, total	EPA Method 340.1/340.2	Not Applicable
Fluoride, soluble	EPA Method 300.0	EPA Method 300.0
Fluoride, bioavailable	GI Extraction Method [d]	Not Applicable
Cyanide (total)	EPA Method 335.2 CLP-M	EPA Method 335.2 CLP-M
Cyanide (amenable)	Not applicable	EPA Method 33.1-M/ 335.2 CLP-M
PAHs (speciated) [a]	EPA Modified Method 8270-SIM	EPA Modified Method 8270-SIM
PCBs (speciated) [b]	CLP	CLP
Hardness	Not applicable	EPA Method 200.7
Metals [c]		
Aluminum	CLP	CLP
Antimony	CLP	CLP
Arsenic	CLP	CLP
Barium	CLP	CLP
Beryllium	CLP	CLP
Cadmium	CLP	CLP
Chromium	CLP	CLP
Copper	CLP	CLP
Lead	CLP	CLP
Mercury	CLP	CLP
Nickel	CLP	CLP
Selenium	CLP	CLP
Silver	CLP	CLP
Thallium	CLP	CLP
Vanadium	CLP	CLP
Zinc	CLP	CLP

[a] Individual PAH parameters include naphthalene, 2-methylnaphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

[b] Individual aroclors include 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268.

[c] Soil samples were analyzed for total metals. Water samples were analyzed for total and dissolved metals; water samples were field-filtered for dissolved metals.

[d] GI Extraction Method for soil as described in *Memorandum WO No. 1: Work Order for QAL Analysis of RMC Soil and Water Samples in 1997* (CH2M HILL, March 12, 1997).

Table 3-3
South Landfill Surface Soil Analytical Results

Report Class	Analyte	Units	SL-SB006 6/18/97	SL-SB012 6/18/97	SL-SB018 6/18/97	SL-SB024 6/18/97	SL-SB030 6/18/97	SL-SB036 6/18/97	SL-SB042 6/18/97	SL-SB048 6/18/97	SL-SB054 6/18/97	SL-SB060 6/18/97
CONV	Fluoride By 300.0	mg/kg	940 D	250 D	300 D	280 D	180 D	410 D	350 D	470 D	1200 D	1600 D
CONV	Fluoride By 340.1/340.2	mg/kg	18000 [J]	9100 [J]	14000 [J]	12000 [J]	8700 [J]	15000 [J]	15000 [J]	6900 [J]	6600 [J]	6200 [J]
CONV	Fluoride, GI Extraction	mg/kg	3670	1400	3230	3020	1700	3880	3180	2850	5940	3870
CONV	Cyanide, Total	mg/kg	3.73	7.85	4.76	2.84	2.79	4.05	3.15	2.37	3.16	1.47
M-TOTAL	Aluminum	mg/kg	33900	21600	28900	29000	20800	29900	34100	16600	37200	17000
M-TOTAL	Antimony	mg/kg	3.6	2.8 U	6.3	6	3 U	4.1	3.6	2.8 U	4.1	2.9 U
M-TOTAL	Arsenic	mg/kg	8.2	9.6	21.1	14.4	14.8	19.5	19	11.3	24.2	6.1
M-TOTAL	Barium	mg/kg	131 [J]	91.9 [J]	127 [J]	121 [J]	113 [J]	100 [J]	95.6 [J]	59.5 [J]	152 [J]	52.5 [J]
M-TOTAL	Beryllium	mg/kg	6 [J]	3 [J]	3.5 [J]	3.4 [J]	2 [J]	3.4 [J]	3.5 [J]	1.6 [J]	3.5 [J]	0.68 [J]
M-TOTAL	Cadmium	mg/kg	2.8	2.6	3.9	5.2	2.7	4.4	3.8	1.4	3.3	1.1
M-TOTAL	Chromium	mg/kg	58.7	43.8	63	129	49.5	83.6	119	30.3	98.1	25
M-TOTAL	Copper	mg/kg	3700 [J]	2510 [J]	2100 [J]	3950 [J]	2000 [J]	5190 [J]	3650 [J]	1240 [J]	4610 [J]	641 [J]
M-TOTAL	Lead	mg/kg	344 [J]	123 [J]	227 [J]	126 [J]	148 [J]	135 [J]	173 [J]	181 [J]	432 [J]	63.1 [J]
M-TOTAL	Mercury	mg/kg	0.2	0.09	0.08	0.22	0.35	0.11	0.12	0.06 U	0.12	0.06 U
M-TOTAL	Nickel	mg/kg	105	112	140	199	109	212	192	90	286	89.4
M-TOTAL	Selenium	mg/kg	1.2 U	1.1 U	1.2 U	1.2 U	1.2 U	2.7	1.4	1.1 U	2	1.1 U
M-TOTAL	Silver	mg/kg	1.2 U	1.1 U	1.2 U	1.9	1.2 U	1.6	1.2	1.1 U	1.2 U	1.1 U
M-TOTAL	Thallium	mg/kg	1.2 U	1.1 U	1.2 U	1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U
M-TOTAL	Vanadium	mg/kg	79	75.1	100	123	80.2	120	142	71.3	172	102
M-TOTAL	Zinc	mg/kg	172	145	231	261	211	215	162	66.9	148	48.1
BNA	2-Methylnaphthalene	mg/kg	3.1 U	73 U	31 U	7.9 U	7.9 U	15 U	19 U	7.5 U	16 U	3.7 U
BNA	Acenaphthene	mg/kg	0.75 J	24 J	7.8 J	2.2 J	1.5 J	2.5 J	4.8 J	2.4 J	8.8 J	1.7 J
BNA	Acenaphthylene	mg/kg	3.1 U	73 U	31 U	7.9 U	7.9 U	15 U	19 U	7.5 U	16 U	3.7 U
BNA	Anthracene	mg/kg	1.3 J	50 J	10 J	3.1 J	3.2 J	4.1 J	7.4 J	2.8 J	9.5 J	2.1 J
BNA	Benzo(a)Anthracene	mg/kg	9.8	330	78	21	29	39	55	24	59	16
BNA	Benzo(a)Pyrene	mg/kg	11	370	91	27	31	50	72	35	82	25
BNA	Benzo(b)Fluoranthene	mg/kg	21	480	130	38	60	86	120	44	100	26
BNA	Benzo(G,H,I)Perylene	mg/kg	6.6	190	46	18	18	25	35	16	43	12
BNA	Benzo(k)Fluoranthene	mg/kg	11	290	83	27	28	47	62	25	49	15
BNA	Chrysene	mg/kg	14	400	97	28	42	52	67	28	73	18
BNA	Dibenzo(a,h)Anthracene	mg/kg	3 J	71 J	21 J	8.7	7.5 J	12 J	18 J	9.7	19	5.3
BNA	Fluoranthene	mg/kg	13	530	110	28	32	51	82	31	76	22
BNA	Fluorene	mg/kg	3.1 U	8.8 J	31 U	1.2 J	7.9 U	15 U	2.9 J	1.1 J	4.7 J	0.87 J
BNA	Indeno(1,2,3-Cd)Pyrene	mg/kg	7.4	200	55	23	21	31	46	24	48	14
BNA	Naphthalene	mg/kg	3.1 U	73 U	31 U	7.9 U	7.9 U	15 U	19 U	7.5 U	16 U	3.7 U
BNA	Phenanthrene	mg/kg	6.4	230	46	15	14	20	38	15	45	12
BNA	Pyrene	mg/kg	11	450	92	26	29	41	59	24	63	18
PEST/PCB	Aroclor 1016	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1221	mg/kg	0.79 U	1.5 U	7.9 U	4 U	1.6 U	3.8 U	3.9 U	3.8 U	1.6 U	1.5 U
PEST/PCB	Aroclor 1232	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1242	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1248	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1254	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1260	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1262	mg/kg	0.39 U	0.73 U	3.9 U	2 U	0.79 U	1.9 U	1.9 U	1.9 U	0.78 U	0.75 U
PEST/PCB	Aroclor 1268	mg/kg	0.54 P	1.8 P	24 P	1.6 P	1.1 P	6	2.1	2	3.2	0.75 U

U = The compound was analyzed for but not detected above method detection limits.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.
D = Results reported at more than one dilution factor.
P = The difference in PCB concentrations exceeded 25 percent. The lower value is reported, per EPA CLP reporting standards.

of the composite data with screening risk levels indicated that all ten of the transects exceeded the screening levels for some constituent. For this reason, discrete samples were not analyzed. The analytical results of the surface soil samples are evaluated for surface exposure risk in Section 3.3.1.

Fluoride. Fluoride was detected in all surface soil samples at south landfill by all three analytical methods. Concentrations of total fluoride ranged from 6,200 J mg/kg to 18,000 J mg/kg; concentrations of fluoride by the GI extraction method ranged from 1,400 to 5,940 mg/kg; and concentrations of soluble fluoride ranged from 180 D mg/kg to 1,600 D mg/kg. Spatially, there were no observable trends of higher or lower fluoride concentrations. The sample with the lowest concentration of total fluoride (SL-SB060) had the highest concentration of soluble fluoride. However, because of the different extraction methods, total fluoride is higher than GI method fluoride, which is higher than soluble fluoride for each sample. The ratio between method results (i.e., total to soluble) varied from one sample to another. This lack of correlation likely indicates the presence of fluoride compounds with differing solubilities at various locations within the landfill.

Cyanide. Cyanide was detected in all 10 surface soil samples at south landfill. Concentrations of total cyanide ranged from 1.47 to 7.85 mg/kg.

Metals. Table 3-4 summarizes the concentrations of metals found in the composite surface soil samples from south landfill. The table shows the maximum concentration, the location of the maximum concentration, and the frequency of detection for each of the metals.

Table 3-4
Metals Concentrations in Surface Soil, South Landfill

Metal	Maximum Concentration Detected (mg/kg)	Location of Maximum Detection	Detection Frequency
Aluminum	37200	SB054	10/10
Antimony	6.3	SB018	6/10
Arsenic	24.2	SB054	10/10
Barium	152 J	SB054	10/10
Beryllium	3.5 J	SB054	10/10
Cadmium	5.2	SB024	10/10
Chromium	129	SB024	10/10
Copper	5190 J	SB036	10/10
Lead	432 J	SB054	10/10
Mercury	0.35	SB030	9/10
Nickel	286	SB054	10/10
Selenium	2.7	SB036	3/10
Silver	1.9	SB024	3/10
Vanadium	172	SB054	10/10
Zinc	261	SB024	10/10

J = The reported value is estimated, since it is below the method reporting limit for the analysis.

PAHs. PAHs were detected in all 10 composite surface soil samples at south landfill; Table 3-5 summarizes the concentrations of PAHs found.

Table 3-5
PAH Concentrations in Surface Soil, South Landfill

Compound	Maximum Concentration (mg/kg)[a]	Minimum Detected Concentration (mg/kg)[b]	Frequency of Detection
2-methylnaphthalene	ND	ND	0/10
Acenaphthene	24 J	0.75 J	10/10
Acenaphthylene	ND	ND	0/10
Aanthracene	50 J	1.3 J	10/10
Benzo(a)anthracene [c]	330	9.8	10/10
Benzo(a)pyrene [c]	370	11	10/10
Benzo(b)fluoranthene [c]	480	21	10/10
Benzo(g,h,i)perylene	190	6.6	10/10
Benzo(k)fluoranthene [c]	290	11	10/10
Chrysene [c]	400	14	10/10
Dibenzo(a,h)anthracene [c]	71 J	3 J	10/10
Fluoranthene	530	13	10/10
Fluorene	8.8 J	1.1 J	6/10
Indeno(1,2,3-cd)pyrene [c]	200	7.4	10/10
Naphthalene	ND	ND	0/10
Phenanthrene	230	6.4	10/10
Pyrene	450	11	10/10

[a] All maximum concentrations were found in sample SL-SB012.
[b] All minimum detected concentrations were found in sample SL-SB006, except fluorene. The minimum detected concentration of fluorene was found in sample SL-SB048; fluorene was not detected in sample SL-SB006.
[c] Indicates carcinogenic PAH.
ND = Not detected above the method detection limit.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.

The PAH compounds detected were acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. With the exception of fluorene, each of these compounds was detected in all 10 surface soil samples.

Detected concentrations of PAHs ranged from 0.075 J mg/kg (acenaphthene in sample SL-SB0006) to 530 mg/kg (fluorene in sample SL-SB012). The highest concentrations of

PAHs were found in SL-SB012, while the lowest concentrations of PAHs were found in SL-SB006.

PCBs. The only PCB compound detected in the surface soil samples at south landfill was Aroclor 1268, which was detected in nine of the ten composite surface soil samples. The concentration of Aroclor 1268 ranged from 0.54 P mg/kg to 24 P mg/kg. The only sample in which Aroclor 1268 was not detected was SL-SB060, from the easternmost transect. The highest concentration of Aroclor 1268 was found in SL-SB018.

3.2.3.2 Surface Water

Table 3-6 provides the analytical results for the surface water samples collected from the swale just south of south landfill. A brief discussion of the results is provided below. The analytical results of the surface water samples are evaluated in Sections 3.3.1 and 3.3.3.

Fluoride. Fluoride was detected in both water samples. The concentration of fluoride was 42.1 and 59.3 mg/L in samples SL-SWO1 and SL-SWO2, respectively.

Cyanide. Total cyanide was detected in both water samples. The concentration of total cyanide was 0.042 and 0.026 mg/L in samples SL-SWO1 and SL-SWO2, respectively.

Metals. Aluminum, beryllium, and copper were the only metals that were detected in the surface water samples, and they were detected in both filtered and unfiltered water samples.

PAHs. PAHs were not detected in either of the surface water samples.

PCBs. PCBs were not detected in either of the surface water samples.

3.2.4 Conceptual Model Refinement

As a refinement to the conceptual model for south landfill, revised cross sections are presented in Figures 3-2, 3-3, and 3-4. These cross sections have been revised from cross sections presented in the Addendum. The revisions were made on the basis of additional geological information made available by the ongoing groundwater investigation.

3.3 Data Evaluation

3.3.1 Preliminary Risk Evaluation for Surface Exposures

3.3.1.1 South Landfill Risk Evaluation

This section presents the results of the surface exposure risk evaluation for south landfill on the basis of the surface soil analytical results in Section 3.2.3.1, the surface water analytical results in Section 3.2.3.2, and subsurface soil analytical results collected during the RSA in July and September 1994. The procedures and approach used to estimate risks are described in the *Draft Human Health and Ecological Risk Assessment Addendum to the RI/FS Work Plan* (CH2M HILL, August 5, 1996). Conceptual exposure models for human and ecological receptors were described in the Addendum and are presented schematically in Figures 3-5 and 3-6.

Table 3-6 South Landfill Surface Water Analytical Results Page 1 of 2				
Report Class	Analyte	Units	SL-SW01 4/28/97	SL-SW02 5/9/97
CONV	Fluoride by 300.0	mg/L	42.1	59.3
CONV	Cyanide, Amenable	mg/L	0.02 U	NA
CONV	Cyanide, Total	mg/L	0.042	0.026
CONV	Hardness, Total	mg/L	20	17
M-DISS	Aluminum	mg/L	5.44	6.26
M-DISS	Antimony	mg/L	0.005 U[J]	0.005 UJ
M-DISS	Arsenic	mg/L	0.004 U	0.004 U
M-DISS	Barium	mg/L	0.02 U	0.02 U
M-DISS	Beryllium	mg/L	0.0046	0.0059
M-DISS	Cadmium	mg/L	0.002 U	0.002 U
M-DISS	Chromium	mg/L	0.01 U	0.01 U
M-DISS	Copper	mg/L	0.0268	0.022
M-DISS	Lead	mg/L	0.001 U	0.001 U
M-DISS	Mercury	mg/L	0.0002 U	0.0002 U
M-DISS	Nickel	mg/L	0.04 U	0.04 U
M-DISS	Selenium	mg/L	0.005 U[J]	0.005 U
M-DISS	Silver	mg/L	0.003 U	0.003 U
M-DISS	Thallium	mg/L	0.002 U[J]	0.002 U
M-DISS	Vanadium	mg/L	0.02 U	0.02 U
M-DISS	Zinc	mg/L	0.05 U	0.05 U
M-TOTAL	Aluminum	mg/L	5.4	5.61
M-TOTAL	Antimony	mg/L	0.005 U[J]	0.005 UJ
M-TOTAL	Arsenic	mg/L	0.004 U	0.004 U
M-TOTAL	Barium	mg/L	0.02 U	0.02 U
M-TOTAL	Beryllium	mg/L	0.0049	0.0054
M-TOTAL	Cadmium	mg/L	0.002 U	0.002 U
M-TOTAL	Chromium	mg/L	0.01 U	0.01 U
M-TOTAL	Copper	mg/L	0.0308	0.0269
M-TOTAL	Lead	mg/L	0.001 U	0.001 U
M-TOTAL	Mercury	mg/L	0.0002 U	0.0002 U
M-TOTAL	Nickel	mg/L	0.04 U	0.04 U
M-TOTAL	Selenium	mg/L	0.005 U	0.005 U
M-TOTAL	Silver	mg/L	0.003 U	0.003 U
M-TOTAL	Thallium	mg/L	0.002 U[J]	0.002 U
M-TOTAL	Vanadium	mg/L	0.02 U	0.02 U

Table 3-6
South Landfill Surface Water Analytical Results

Page 2 of 2

Report Class	Analyte	Units	SL-SW01 4/28/97	SL-SW02 5/9/97
M-TOTAL	Zinc	mg/L	0.05 U	0.05 U
BNA	2-Methylnaphthalene	mg/L	0.01 U	0.01 U
BNA	Acenaphthene	mg/L	0.01 U	0.01 U
BNA	Acenaphthylene	mg/L	0.01 U	0.01 U
BNA	Anthracene	mg/L	0.01 U	0.01 U
BNA	Benzo(a)Anthracene	mg/L	0.01 U	0.01 U
BNA	Benzo(a)Pyrene	mg/L	0.01 U	0.01 U
BNA	Benzo(b)Fluoranthene	mg/L	0.01 U	0.01 U
BNA	Benzo(G,H,I)Perylene	mg/L	0.01 U	0.01 U
BNA	Benzo(k)Fluoranthene	mg/L	0.01 U	0.01 U
BNA	Chrysene	mg/L	0.01 U	0.01 U
BNA	Dibenzo(a,h)Anthracene	mg/L	0.01 U	0.01 U
BNA	Fluoranthene	mg/L	0.01 U	0.01 U
BNA	Fluorene	mg/L	0.01 U	0.01 U
BNA	Indeno(1,2,3-Cd)Pyrene	mg/L	0.01 U	0.01 U
BNA	Naphthalene	mg/L	0.01 U	0.01 U
BNA	Phenanthrene	mg/L	0.01 U	0.01 U
BNA	Pyrene	mg/L	0.01 U	0.01 U
PEST/PCB	Aroclor 1016	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1221	mg/L	0.002 U	0.002 U
PEST/PCB	Aroclor 1232	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1242	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1248	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1254	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1260	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1262	mg/L	0.001 U	0.001 U
PEST/PCB	Aroclor 1268	mg/L	0.001 U	0.001 U

NA = Not analyzed.
U = The compound was analyzed for but not detected.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.

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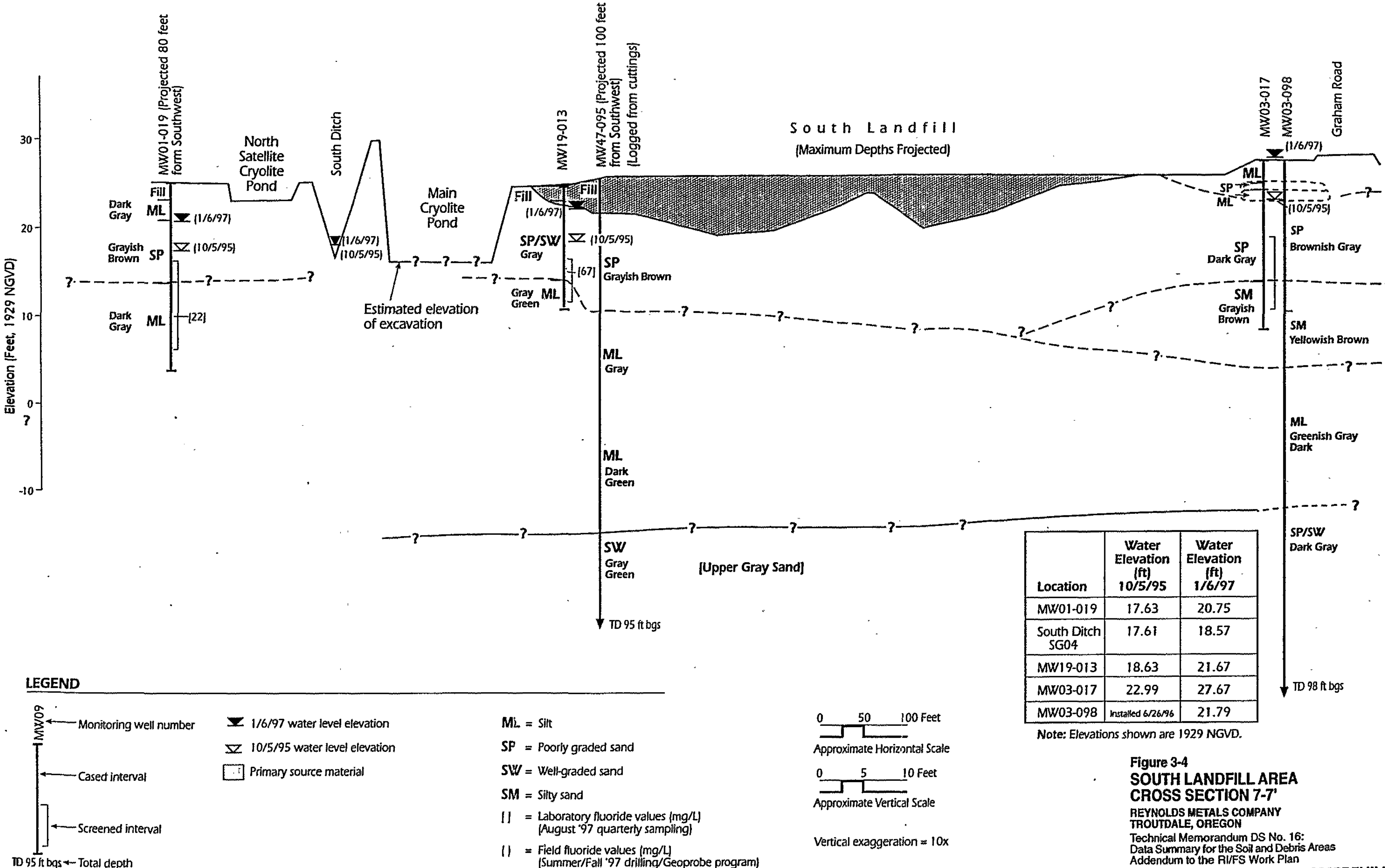
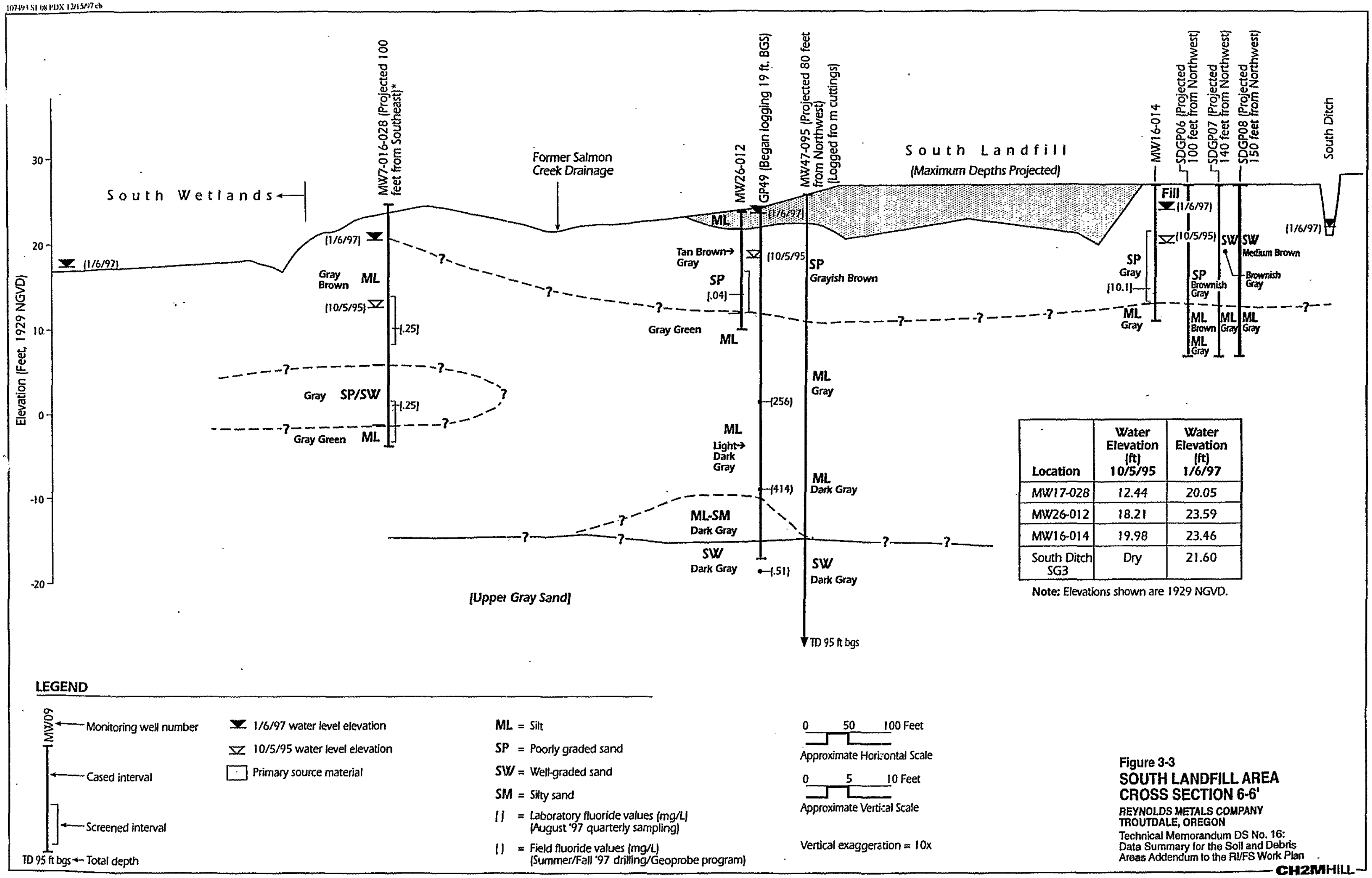


Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW01-019	17.63	20.75
South Ditch SG04	17.61	18.57
MW19-013	18.63	21.67
MW03-017	22.99	27.67
MW03-098	Installed 6/26/96	21.79

Note: Elevations shown are 1929 NGVD.

Figure 3-4
SOUTH LANDFILL AREA CROSS SECTION 7-7'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas
Addendum to the RI/FS Work Plan

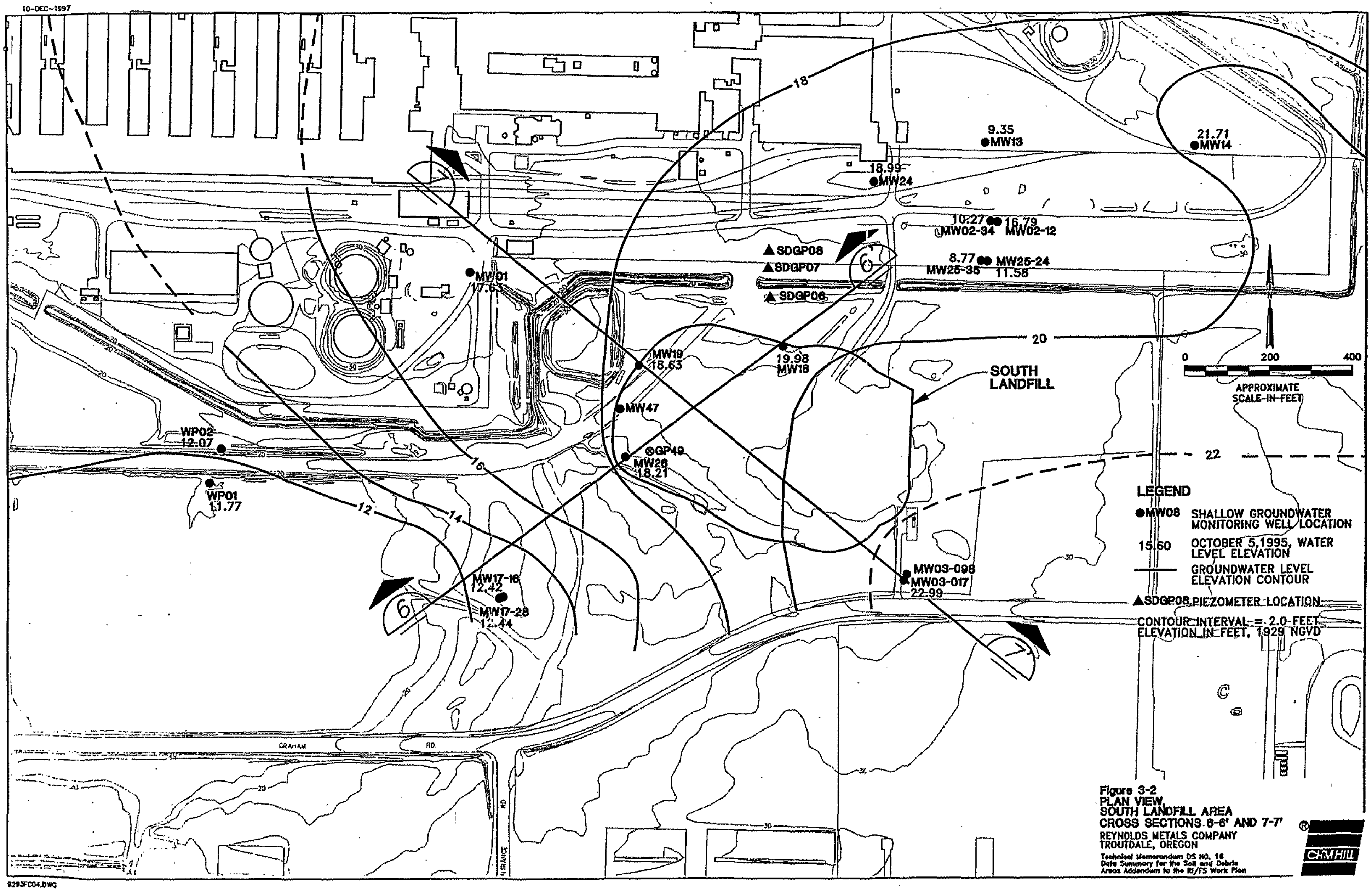
CH2MHILL



Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW17-028	12.44	20.05
MW26-012	18.21	23.59
MW16-014	19.98	23.46
South Ditch SG3	Dry	21.60

Note: Elevations shown are 1929 NGVD.

Figure 3-3
SOUTH LANDFILL AREA CROSS SECTION 6-6'
REYNOLDS METALS COMPANY TROUTDALE, OREGON
Technical Memorandum DS No. 16: Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan


10-DEC-1997
18
9.35
MW13
21.71
MW14
18.99
MW24
10.27
MW02-34
16.79
MW02-12
SDGP08
SDGP07
SDGP06
8.77
MW25-35
MW25-24
11.58
MW01
17.63
MW19
18.63
19.98
MW18
20
SOUTH LANDFILL
0 200 400
APPROXIMATE SCALE IN FEET
MW47
WP02
12.07
GP49
MW26
18.21
22
WP01
11.77
12
14
16
LEGEND
MW08 SHALLOW GROUNDWATER MONITORING WELL LOCATION
15.60 OCTOBER 5,1995, WATER LEVEL ELEVATION
GROUNDWATER LEVEL ELEVATION CONTOUR
SDGP08 PIEZOMETER LOCATION
CONTOUR INTERVAL = 2.0 FEET
ELEVATION IN FEET, 1929 NGVD
MW17-16
12.42
MW17-28
12.44
MW03-098
MW03-017
22.99
6
6'
7
7'
GRAHAM RD.
Figure 3-2
PLAN VIEW,
SOUTH LANDFILL AREA
CROSS SECTIONS 6-6' AND 7-7'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS NO. 18
Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan
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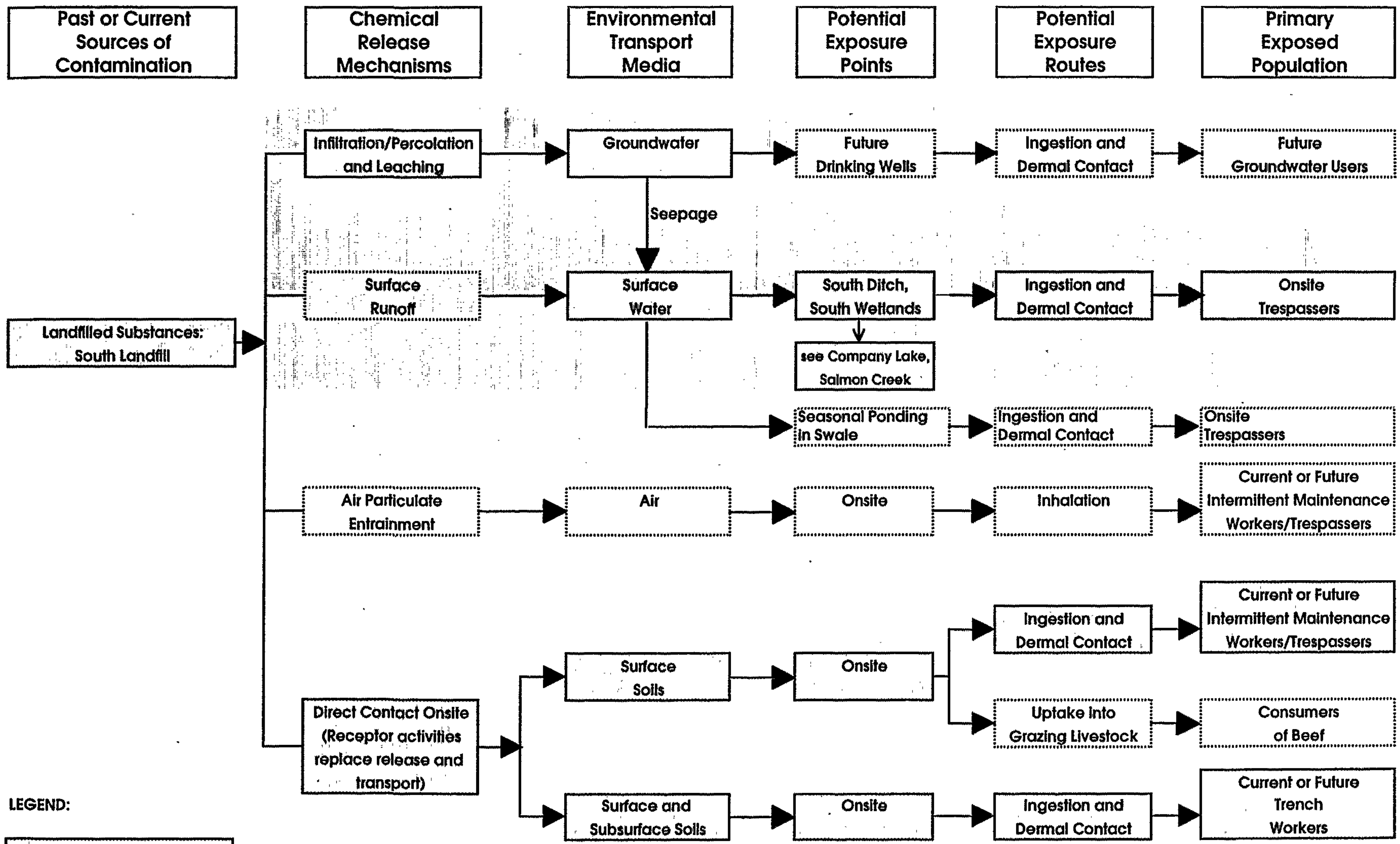

LEGEND:

Likely Pathway

Minor Pathway

Pathway not addressed in this addendum

Figure 3-5
CONCEPTUAL MODEL FOR POTENTIAL HUMAN EXPOSURES AT SOUTH LANDFILL
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

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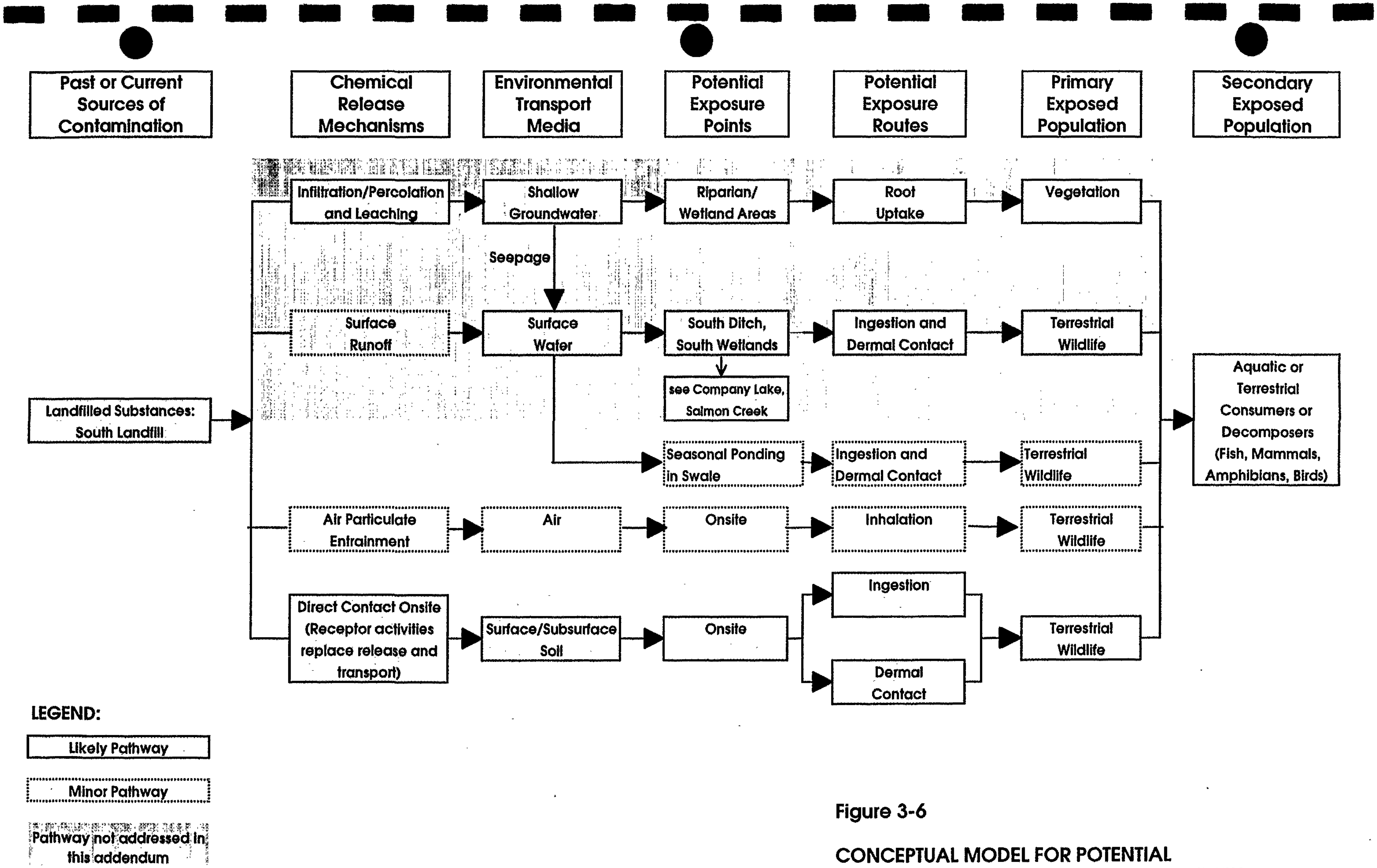

Figure 3-6

CONCEPTUAL MODEL FOR POTENTIAL ECOLOGICAL EXPOSURES AT SOUTH LANDFILL
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas Addendum
to the RI/FS Work Plan

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3.3.1.2 Data Representativeness

Data needs for exposure and spatial representativeness, based on the results of a preliminary evaluation of data representativeness for risk assessment, were identified in the Addendum. To address these data needs, the surface soil sampling program described in Section 3.2.1.1 provided adequate coverage to yield a reliable estimate of exposure across the landfill surface. Because the soil samples were collected from the depth where contact by maintenance workers and trespassers is most feasible (0 to 6 inches bgs), the data are considered to be representative with respect to exposure.

Data from 42 soil samples, taken at depths to 8 ft bgs, were aggregated to estimate exposure point concentrations for hypothetical trench workers. The soil samples were collected from depths at which exposure to trench workers is feasible, and the data are considered to be representative with respect to trench worker exposure.

For the purposes of the risk evaluation for soil exposures, the areal extent of exposure for intermittent maintenance workers, trespassers, trench workers, and ecological receptors was assumed to be the whole area of south landfill. To capture the spatial heterogeneity of the constituent concentrations in south landfill, the transects were spaced evenly across the area. The density and aerial coverage of the samples collected are considered to adequately represent concentrations over the expected area of exposure for human and ecological receptors.

Two surface water samples were collected in the south landfill depression in order to evaluate potential direct contact risks. These samples were analyzed for inorganics, PAHs, and PCBs. Since these constituents are those most prevalent in the landfill and could occur in the depression, the data are deemed chemically representative. Because the surface water samples were collected in locations where human and ecological exposures are possible, the data are representative of potential exposure. Because of the spatial mixing of surface water in the depression, the surface water data from the depression are considered spatially representative of potential ecological and human exposures for risk analysis.

3.3.1.3 Risk Estimates

Potential Human Exposures to Soil and Surface Water. The primary exposure media in the south landfill are soil and surface water containing site-related constituents. RMC does not use this area at present, and it probably will not use it in its current condition because of its uneven surface and the presence of debris. However, a conservative assumption was made for the purpose of estimating risk. Intermittent maintenance workers, trespassers, and trench workers have been identified as potential human receptors in this area. The following assumptions were used to estimate potential reasonable maximum exposure for these receptors:

- A 70-kg maintenance worker is assumed to frequent the south landfill area 26 days per year over 25 years of employment, inadvertently consuming 50 mg of surface soil/day
- A 70-kg trespasser is assumed to frequent the south landfill 26 days per year for 5 years, inadvertently consuming 100 mg of surface soil/day or 0.025 liters (L) of surface water/day

- A 70-kg trench worker is assumed to be exposed to excavated soil within south landfill for 20 days per year during a 7-year period, inadvertently consuming 480 mg of soil/day

The noncancer and excess lifetime cancer risk estimates for intermittent maintenance workers, trespassers, and trench workers are summarized in Table 3-7. The exposure assumptions and risk calculation data tables are provided in Attachment B.

Table 3-7
Summary of Risk Estimates for South Landfill Soil

		Average Exposure		Reasonable Maximum Exposure	
Exposure Case	**Exposure Scenario**	**Noncancer Hazard Index**	**Excess Lifetime Cancer Risk**	**Noncancer Hazard Index**	**Excess Lifetime Cancer Risk**
South Landfill - Surface Soil	Intermittent Maintenance Worker	N/C[1]	5.3×10^{-6}	0.022	2.9×10^{-5}
South Landfill - Surface Soil	Trespasser	N/C[1]	8.9×10^{-7}	0.06	1.2×10^{-5}
South Landfill - Surface Water in Depression	Trespasser	N/C[1]	N/C[1]	0.03	5.1×10^{-8}
South Landfill - Subsurface Soil	Trench Worker	N/C[1]	4.7×10^{-7}	0.16	3.1×10^{-5}

N/C = Not calculated
[1]Average exposure scenario is not calculated when the reasonable maximum exposure scenario results in acceptable risk levels.

The exposure point concentrations were estimated by reviewing the maximum concentrations detected in each exposure medium and the upper 95 percent confidence limit on the arithmetic mean of the samples for each constituent. The lower of the two concentrations was used as the exposure point concentration for risk quantification. The primary risk contributors in south landfill soil are PAHs, with benzo(a)pyrene contributing approximately 65 percent of the total risk, at an estimated exposure point concentration of 141 mg/kg for a surface soil exposure and 71 mg/kg for a trench worker exposure.

The aggregate risk estimates for the south landfill for all exposure scenarios are below EPA's target noncancer hazard index of 1.0 and a target excess cancer risk of 1×10^{-4}. The RME risk estimates for exposure to soil in south landfill exceed the DEQ acceptable human health excess cancer risk level of 1×10^{-5} for cumulative constituent exposure, but they are below the DEQ acceptable human health hazard index of <1.0. For all three exposure scenarios, the individual chemical risk estimate for benzo(a)pyrene exceeds the DEQ acceptable human health excess cancer risk level of 1×10^{-6} for a single carcinogen.

Risk estimates for surface water are below EPA's target risk levels of an excess cancer risk of $\leq 1 \times 10^{-4}$. Surface water risk estimates are also below the DEQ acceptable human health excess cancer risk level for single carcinogens (1×10^{-6}) and for cumulative risk (1×10^{-5}). They are also below the EPA and DEQ acceptable human health hazard index of <1.0.

The dermal pathway is not quantified for PAHs in this preliminary risk assessment because of the uncertainties associated with risks from PAHs via this route. Toxicity values do not exist for the dermal route of exposure. If dermal exposure to PAHs occurs, the potential risks could be higher than the estimates provided in Table 3-7.

Potential Ecological Exposures to Soil and Surface Water. Conservative ecological screening levels were compared with exposure point concentrations for surface soil and surface water at south landfill to identify chemicals of potential concern for terrestrial and avian receptors. The results of this screening evaluation are presented in Tables B-13 and B-25 in Attachment B. No chemicals exceeded the ecological screening levels for surface water. Aluminum, copper, fluoride, lead, and vanadium exceed ecological screening levels for surface soil. The bioavailability of these metals is being evaluated, and a refined analysis that incorporates the bioavailable fraction and area use by wildlife will be presented in the sitewide baseline risk assessment.

3.3.1.4 Summary of the Preliminary Risk Evaluation

The preliminary risk evaluation results indicate that potential RME risks to intermittent maintenance workers, trespassers, and trench workers exposed to south landfill soil exceed DEQ but are below EPA acceptable excess cancer risk levels. Some constituents have been identified as chemicals of potential ecological concern, and they require further evaluation.

3.3.2 Evaluation of Constituents in Water Samples

The analytical results for the standing water in the swale just south of south landfill (presented in Section 3.2.3.2) were evaluated for surface exposure risk in Section 3.3.1 of this data summary.

The source and significance of the surface water in the swale, as well as an evaluation of the migration pathways from south landfill either by surface runoff or shallow groundwater discharge, will be evaluated in an analysis of groundwater/surface water interactions to be completed in 1998. Infiltration/percolation and surface runoff pathways at south landfill are not addressed by the Addendum or this data summary.

Section 4

Scrap Yard

SECTION 4

Scrap Yard

4.1 Background

The scrap yard is an approximately 5 ¾ acre area located in the southeastern portion of the Troutdale facility just north of the South Ditch (see Figure 1-1). The scrap yard is flat, sparsely vegetated, and inside the facility fence. Historically, various types of debris have been deposited and stored in the scrap yard, including brick fill, scrap metal, and other materials. Depth of the debris is typically less than 2 feet.

Several investigations of the scrap yard have occurred over the past few years. In 1993, PRC Environmental, Inc., conducted a Site Inspection Prioritization study for EPA. CH2M HILL performed a removal site assessment in 1994 and a supplemental data-gathering investigation in 1995.

Although the Addendum identified no data needs for the scrap yard, questions later arose about the usability of the PCB data for surface soil samples collected during the supplemental data-gathering investigation in 1995. Since the surface exposure risk evaluation presented in the Addendum included these data, resampling and analysis of surface soils for PCBs were determined to be needed for the scrap yard. This section reports the data and results of the revised surface exposure risk evaluation.

4.2 1997 Sampling

4.2.1 Data Collection Procedures

Nine discrete surface soil samples were collected at the scrap yard on October 23, 1997. The sample locations are shown on Figure 4-1. The surface soil sample locations were surveyed to reproduce, as nearly as possible, the locations sampled in July 1995.

At each sample location, soil was collected from 0 to 6 inches bgs and placed directly into individual sample jars. Several of the sample locations in the eastern and southern parts of the scrap yard were vegetated with blackberries and other vegetation; sample collection in these locations required that vegetation, including roots, be cleared prior to sample collection.

4.2.2 Analytical Methods

During the supplemental data-gathering investigation in 1995, discrete surface soil samples were collected from nine locations within the scrap yard. OAL analyzed these surface soil samples for PCBs, as well as for other organic and inorganic constituents. Analytical results of the supplemental data-gathering investigation were presented in detail in the *Draft Current Situation Summary* (CH2M HILL, April 5, 1996).

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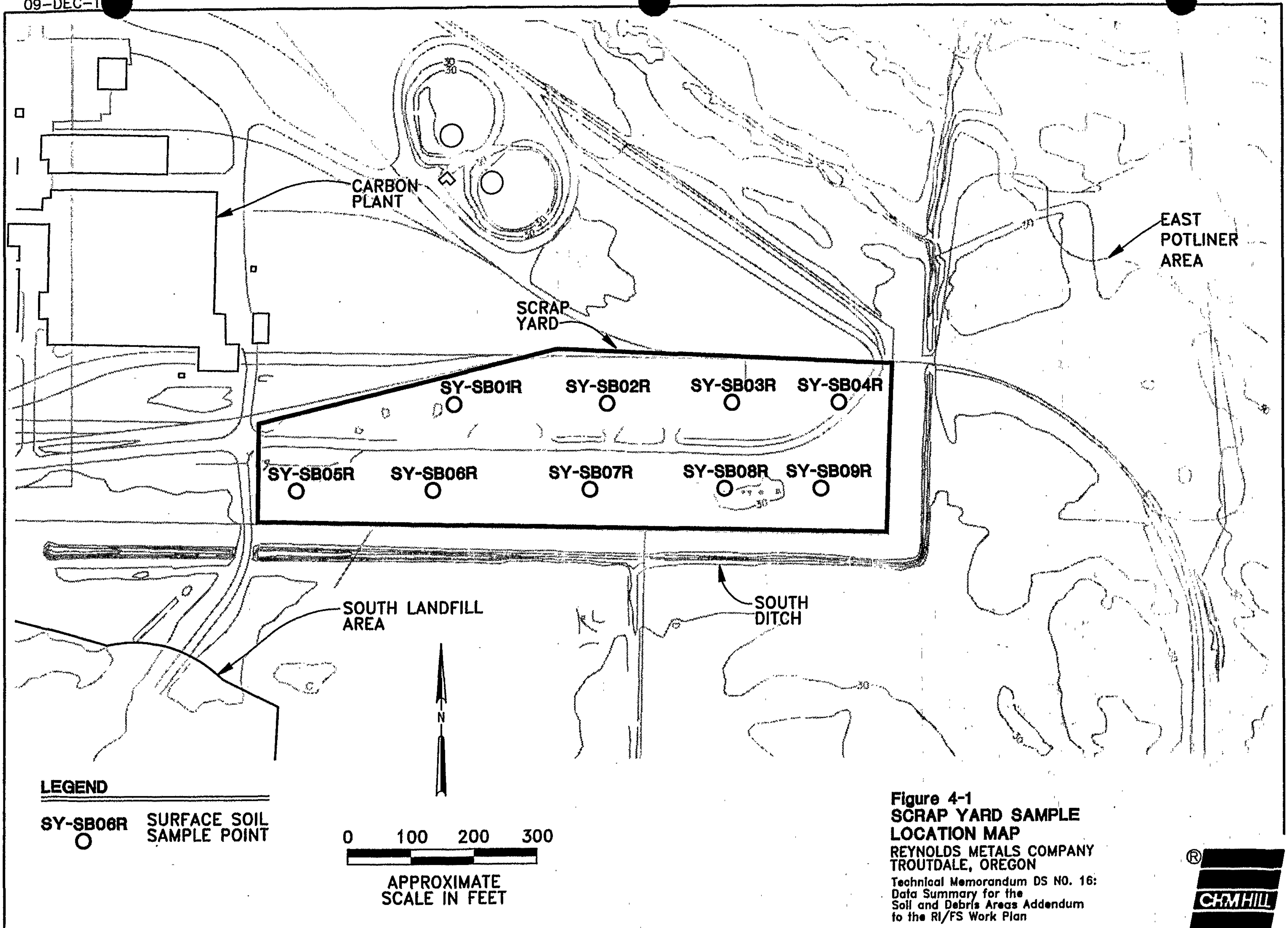

Figure 4-1
SCRAP YARD SAMPLE LOCATION MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS NO. 16: Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

CH2MHILL

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A standard laboratory audit of OAL in September 1996 indicated that the OAL sample preparation/extraction methodology for PCB analyses differed from EPA standard methodology [EPA SW846 and Contract Laboratory Program (CLP)]. The OAL standard operating methodology for all PCB sample preparations was a laboratory-specific shakeout procedure developed for quick turnaround.

As a result of the laboratory audit findings, an interlaboratory comparative study was performed to evaluate the usability of OAL PCB data, including the 1995 PCB results for soil samples collected from the scrap yard. The results of the comparative study are presented in *Technical Memorandum No. 4: Interlaboratory Data Comparison for RMC-Troutdale* (CH2M HILL, September 16, 1997). The interlaboratory comparison study results indicated that, for higher PCB concentrations in soil (greater than 10 mg/kg), the OAL results may be biased low. The results also indicated that the significance of the observed differences at concentrations greater than 10 mg/kg (including two of the nine samples from the scrap yard) needs to be evaluated on an area-specific basis.

QAL analyzed the discrete surface soil samples collected during the resampling effort. The samples were analyzed for PCBs by CLP method, as described in *Memorandum WO No. 1: Work Order for QAL Analysis of RMC Soil and Water Samples in 1997* (CH2M HILL, March 12, 1997). Because of matrix interference, all samples were analyzed on a diluted basis, resulting in higher detection limits.

4.2.3 Analytical Results

The analytical results for the surface soil samples from the scrap yard are provided in Table 4-1. The table shows the concentrations of individual PCB compounds (from the 1997 sampling), as well as the concentration of total PCBs from the 1995 supplemental data-gathering investigation.

Table 4-1
PCB Concentrations in Surface Soil, Scrap Yard

	1997 Sample Results									1995 Results
Sample No.*	Aroclor 1016 mg/kg	Aroclor 1221 mg/kg	Aroclor 1232 mg/kg	Aroclor 1242 mg/kg	Aroclor 1248 mg/kg	Aroclor 1254 mg/kg	Aroclor 1260 mg/kg	Aroclor 1262 mg/kg	Aroclor 1268 mg/kg	Total PCBs mg/kg
SY-SB01R	0.360 U	0.730 U	0.360 U	0.360 U	0.360 U	1.100 JP	0.360 U	0.360 U	0.670 JP	10.400
SY-SB02R	3.800 U	7.700 U	3.800 U	3.800 U	3.800 U	3.800 U	3.800 U	3.800 U	3.800 U	29.100
SY-SB03R	3.900 U	8.000 U	3.900 U	3.900 U	3.900 U	3.900 U	3.900 U	3.900 U	3.900 U	5.440
SY-SB04R	4.200 U	8.600 U	4.200 U	4.200 U	4.200 U	4.200 U	4.200 U	4.200 U	4.200 U	0.811
SY-SB05R	3.600 U	7.300 U	3.600 U	3.600 U	3.600 U	3.600 U	3.600 U	3.600 U	3.600 U	0.927
SY-SB06R	0.180 U	0.370 U	0.180 U	0.180 U	0.180 U	0.180 U	0.180 U	0.180 U	0.180 JP	9.160
SY-SB07R	0.190 U	0.390 U	0.190 U	0.190 U	0.190 U	0.190 U	0.190 U	0.190 U	0.420 JP	0.497
SY-SB08R	0.190 U	0.390 U	0.190 U	0.190 U	0.190 U	0.190 U	0.190 U	0.190 U	0.190 U	2.840
SY-SB09R	0.390 U	0.800 U	0.390 U	0.390 U	0.390 U	0.390 U	0.390 U	0.390 U	0.390 U	1.380

* Soil sample numbers are the October 1997 sample designations. However, the 1997 sample locations were surveyed to represent, as nearly as possible, the July 1995 sample locations.
P = The difference in PCB concentrations between the two columns of the analytical instrument exceeded 25 percent. The lower value is reported, per EPA CLP reporting standards.
J = The reported value is estimated, since it is below the method reporting limit for the analysis.
U = The compound was analyzed for but not detected.

PCB compounds that were detected in the surface soil samples were Aroclors 1254 and 1268. Aroclor 1254 was detected in one of the nine samples at a concentration of 1.1 JP mg/kg, and Aroclor 1268 was detected in three of the nine samples at a maximum concentration of 0.67 JP mg/kg. The maximum concentration of PCB compounds was found in sample SY-SB01R.

4.2.4 Conceptual Model Refinement

As a refinement to the conceptual model for the scrap yard, revised cross sections are presented in Figures 4-2, 4-3, and 4-4. These cross sections have been revised from cross sections presented in the Addendum on the basis of additional geological information made available by the ongoing sitewide groundwater investigation.

4.3 Data Evaluation

4.3.1 Comparison of 1997 and 1995 PCB Data

The purpose of collecting the surface soil samples at the scrap yard and analyzing them for PCBs was to confirm the concentration of PCBs in scrap yard surface soil, and to confirm the results of the preliminary evaluation of the scrap yard that were presented in the Addendum. Rather than resample and analyze the two sample locations in question using both methods, all nine locations were resampled and analyzed using the EPA CLP method. This approach was conservative but provided consistent data for risk evaluation. As shown in Table 4-1, the concentration of detected individual PCBs in all samples is less than the concentration of total PCBs from the 1995 investigation.

Because of interference from the sample matrix, all samples were analyzed on a diluted basis, and reporting limits were adjusted accordingly. Consequently, there are several samples (SY-SB03R, SY-SB04R, and SY-SB05R) in which the reporting limits for the individual PCB compounds are higher than the concentration of total PCBs from the 1995 investigation. It should be noted, however, that according to the results of the interlaboratory comparison study, only the 1995 samples with concentrations of PCBs greater than 10 mg/kg were in question, and these results may be biased low. The 1995 results of samples corresponding to SY-SB03R, SY-SB04R, and SY-SB05R were less than 10 mg/kg and, hence, not in question. Sample SY-SB02R contained 29.1 mg/kg in 1995, but the 1997 results had anomalously high detection limits. However, use of these nondetect values to estimate potential exposure concentrations of PCBs for the scrap yard as a whole (using one-half the detection limit) does not result in a significantly different estimate for 1997 (approximately 15 mg/kg) versus 1995 (approximately 12 mg/kg).

4.3.2 Evaluation of Surface Exposure Risk for the Scrap Yard

In general, the results of PCB analyses in the 1997 samples confirmed the results of the 1995 supplemental data-gathering investigation data that were used for the scrap yard risk evaluation in the Addendum. Therefore, the conclusions of the risk evaluation as reported in the Addendum are confirmed: Potential risks to human populations exposed to scrap yard surface soil are below target risk levels generally considered by EPA to require remediation, but potential risks to human populations likely to be exposed to scrap yard surface soil exceed DEQ acceptable human health excess cancer risk levels.

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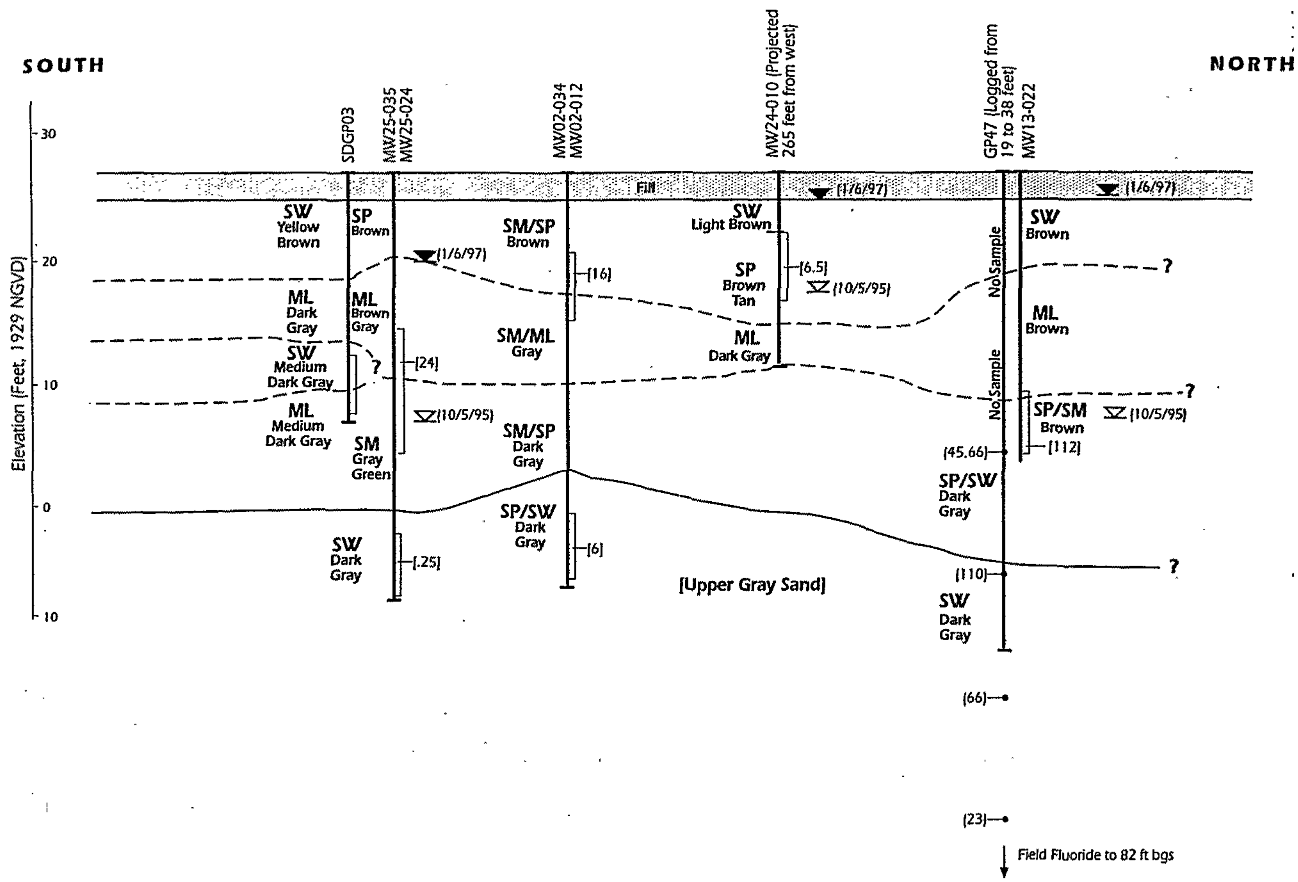


Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW25-035	8.77	21.97
MW02-034	NA	21.99
MW24-010	18.99	25.26
MW13-022	9.35	25.23

Note: Elevations shown are 1929 NGVD.

LEGEND

- MW09 ← Monitoring well number
- ← Cased interval
- ← Screened interval
- 1/6/97 water level elevation
- 10/5/95 water level elevation
- Primary source material

ML = Silt
SP = Poorly graded sand
SW = Well-graded sand
SM = Silty sand
[ ] = Laboratory fluoride values (mg/L) (August '97 quarterly sampling)
( ) = Field fluoride values (mg/L) (Summer/Fall '97 drilling/ Geoprobe program)

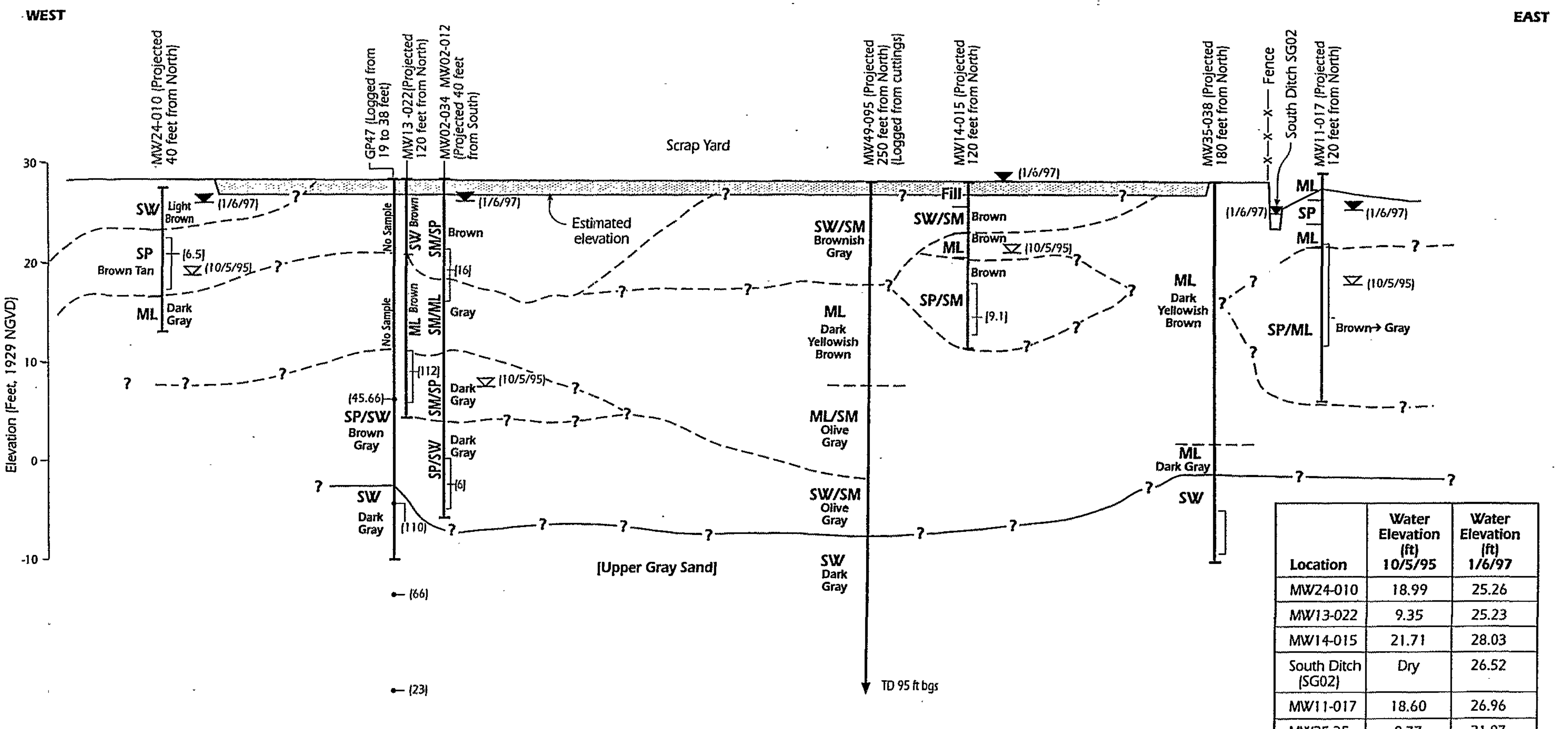
0 50 100 Feet
Approximate Horizontal Scale

0 5 10 Feet
Approximate Vertical Scale

Vertical exaggeration = 10x

Figure 4-4
SCRAP YARD CROSS SECTION 12-12'
REYNOLDS METALS COMPANY TROUTDALE, OREGON
Technical Memorandum DS No. 16: Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan

CH2MHILL



Location	Water Elevation (ft) 10/5/95	Water Elevation (ft) 1/6/97
MW24-010	18.99	25.26
MW13-022	9.35	25.23
MW14-015	21.71	28.03
South Ditch (SG02)	Dry	26.52
MW11-017	18.60	26.96
MW25-35	8.77	21.97
MW02-34	—	—
MW35-038	Installed 12/3/96	21.18

Note: Elevations shown are 1929 NGVD.

LEGEND

- MW09 ← Monitoring well number
- ← Cased interval
- ← Screened interval
- TD 95 ft bgs ← Total depth
- 1/6/97 water level elevation
- 10/5/95 water level elevation
- Primary source material
- ML = Silt
- SP = Poorly graded sand
- SW = Well-graded sand
- [ ] = Laboratory fluoride values (mg/L) (August '97 quarterly sampling)
- ( ) = Field fluoride values (mg/L) (Summer/Fall '97 drilling/ Geoprobe program)

0 50 100 Feet
Approximate Horizontal Scale

0 5 10 Feet
Approximate Vertical Scale

Vertical exaggeration = 10x

Figure 4-3
SCRAP YARD CROSS SECTION 11-11'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16:
Data Summary for the Soil and Debris Areas
Addendum to the RI/FS Work Plan

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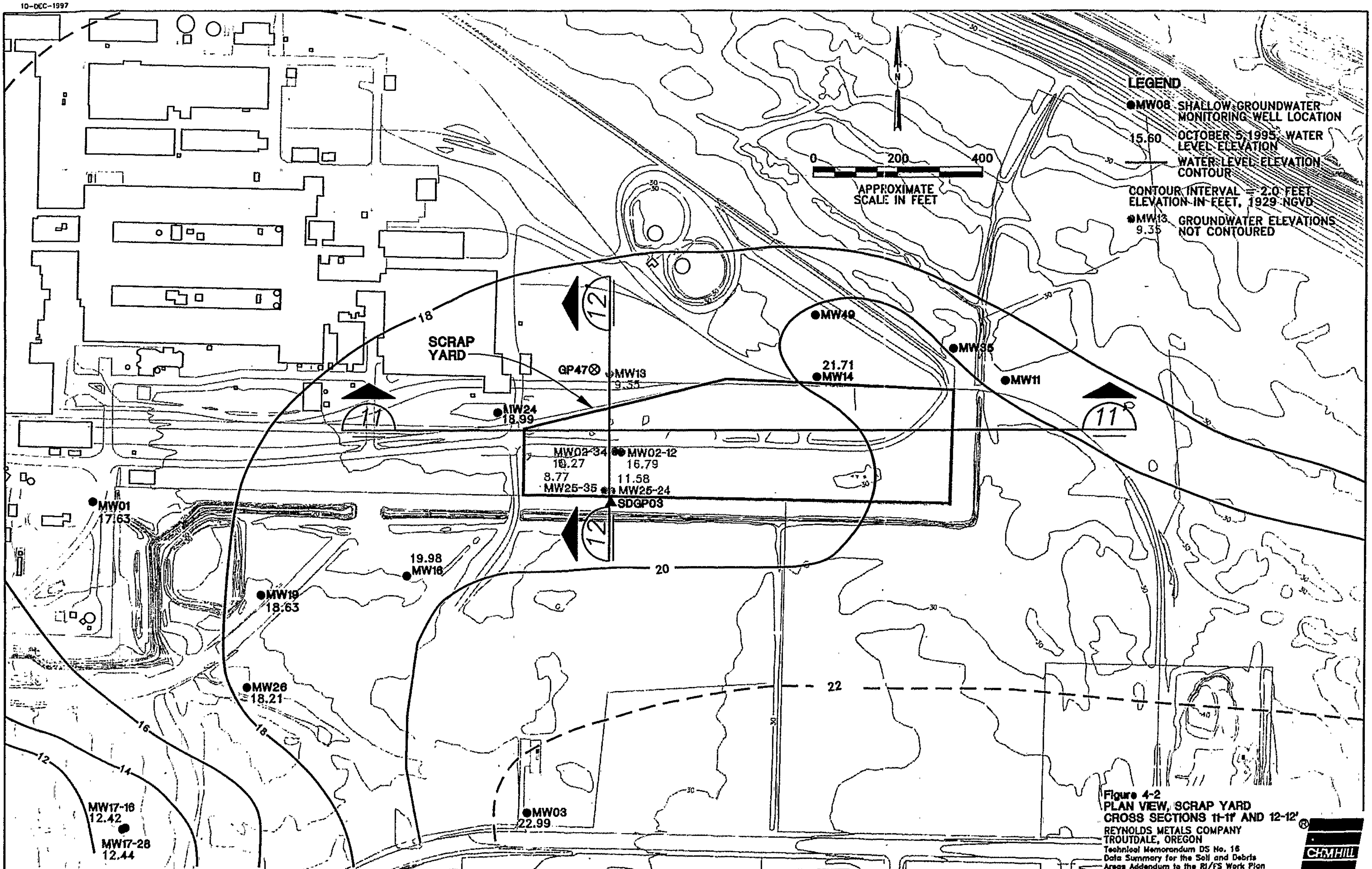

Figure 4-2
PLAN VIEW, SCRAP YARD
CROSS SECTIONS 11-11' AND 12-12'
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Technical Memorandum DS No. 16
Data Summary for the Soil and Debris Areas Addendum to the RI/FS Work Plan
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SECTION 5

References

SECTION 5

References

CH2M HILL. *Cryolite Removal Action Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. December 1994.

____________. *Memorandum WP No. 7: Final East Potliner Area Work Plan for Removal Action*. Prepared for Reynolds Metals Company, Troutdale Facility. October 11, 1995.

____________. *Memorandum WP No. 21: Draft Casthouse Interior Removal Action Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. February 20, 1996.

____________. *Draft Current Situation Summary*. Prepared for Reynolds Metals Company, Troutdale Facility. April 5, 1996.

____________. *Final Report: Cryolite Pond Area Removal Action*. Prepared for Reynolds Metals Company, Troutdale Facility. April 11, 1996.

____________. *Draft South Wetlands Addendum to the RI/FS Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. May 8, 1996.

____________. *Memorandum WP No. 10: PCB Spill Area Removal Action Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. May 30, 1996.

____________. *Memorandum WP No. 17: Bakehouse Sumps Area Removal Action Work Plan, Phase 1—Well Point Abandonment*. Prepared for Reynolds Metals Company, Troutdale Facility. May 30, 1996.

____________. *Draft Human Health and Ecological Risk Assessment Addendum to the RI/FS Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. August 5, 1996.

____________. *Technical Memorandum DS No. 14: Data Summary for the South Wetlands Addendum to the RI/FS Work Plan, Part 1—Soil, Surface Water, and Groundwater Quality*. Prepared for Reynolds Metals Company, Troutdale Facility. February 12, 1997.

____________. *Draft Soil and Debris Areas Addendum to the RI/FS Work Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. February 18, 1997.

____________. *Memorandum WO No. 1: Work Order for QAL Analysis of RMC Soil and Water Samples in 1997*. Prepared for Reynolds Metals Company, Troutdale Facility. March 12, 1997.

____________. *Technical Memorandum DS No. 15: Company Lake Supplemental Data Summary*. Prepared for Reynolds Metals Company, Troutdale Facility. March 26, 1997.

____________. *Final Report: East Potliner Area Removal Action*. Prepared for Reynolds Metals Company, Troutdale Facility. April 3, 1997.

____________. *Draft Sampling and Analysis Plan*. Prepared for Reynolds Metals Company, Troutdale Facility. July 1997.

___________. *Technical Memorandum No. 4: Interlaboratory Data Comparison for RMC-Troutdale*. Prepared for Reynolds Metals Company, Troutdale Facility. September 16, 1997.

___________. PCB Spill Area Removal Action Report. Being prepared for Reynolds Metals Company, Troutdale Facility. In progress. Winter 1997-98.

___________. Bakehouse Sumps Area Removal Action Report. Being prepared for Reynolds Metals Company, Troutdale Facility. In progress. Winter 1997-98.

___________. Baseline Risk Assessment for South Wetlands Surface Exposures. To be prepared for Reynolds Metals Company, Troutdale Facility. Planned for 1998.

U.S. Army Corps of Engineers. *Design Memorandum, Sandy Drainage District, Lower Columbia River Improvement to Existing Works, Oregon and Washington.* Prepared by the Department of the Army, Portland District, Corps of Engineers. Portland, Oregon. December 30, 1953.

U.S. Environmental Protection Agency. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*. Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30. April 22, 1991.

___________. *Removal Action Statement of Work No. 1.* March 1995.

ATTACHMENT A

North Landfill Exposure Assumptions and Risk Calculations

TABLE A-1 EXPOSURE ASSUMPTIONS FOR DIRECT CONTACT RISK EVALUATION North Landfill Soil		
EXPOSURE ASSUMPTIONS	**RME**	**AVG**
Exposure Setting	Maintenance Worker	Maintenance Worker
Exposure Case	Reasonable Maximum	Average
Daily Soil Intake (mg/day)	50	50
Body Weight (kg)	70	70
Number of Days/Week Exposed	1	1
Number of Weeks/Year Exposed	26	12
Number of Years Exposed	25	10
Averaging Time: Cancer (yr)	70	70
Averaging Time: Noncancer (yr)	25	10
Exposed Body Part(s)	Hands	Hands
Exposed Skin Surface Area - Adult (cm^2)	1130	840
Soil Contact Rate (mg/day) - Adult	1130	168
Soil to Skin Adherence Factor (mg/cm^2)	1.00	0.20

TABLE A-2
SUMMARY STATISTICS: COMPOSITE SURFICIAL SOIL SAMPLES
North Landfill

Data for Composite Surficial Soil Samples Collected in Summer 1997 - North Landfill

Method	Analyte	Units	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Geometric Mean	Standard Deviation	Coefficient of Variation	Upper 95% Confidence-t	RME
BNA	Acenaphthene	mg/KG	4	5	0.8	0.87	0.87	0.055	16	3.4	4.75E-01	7.04E+00	2.07E+00	1.01E+01	1.01E+01
M-TOTAL	Aluminum	mg/KG	5	5	1			9260	25600	17352	1.61E+04	7.18E+03	4.14E-01	2.42E+04	2.42E+04
BNA	Anthracene	mg/KG	5	5	1			0.089	26	5.3958	5.47E-01	1.15E+01	2.13E+00	1.64E+01	1.64E+01
M-TOTAL	Antimony	mg/KG	1	5	0.2	2.8	3.4	3.5	3.5	1.97	1.86E+00	8.63E-01	4.38E-01	2.79E+00	2.79E+00
PEST/PCB	Aroclor 1268	mg/KG	2	5	0.4	0.9	4.5	1.2	2.9	1.73	1.45E+00	9.45E-01	5.46E-01	2.63E+00	2.63E+00
M-TOTAL	Arsenic	mg/KG	5	5	1			2.8	13	6.88	5.96E+00	4.03E+00	5.86E-01	1.07E+01	1.07E+01
M-TOTAL	Barium	mg/KG	5	5	1			46.4	108	80.34	7.75E+01	2.21E+01	2.75E-01	1.01E+02	1.01E+02
BNA	Benzo(a)Anthracene	mg/KG	5	5	1			0.76	170	35.912	5.01E+00	7.50E+01	2.09E+00	1.07E+02	1.07E+02
BNA	Benzo(a)Pyrene	mg/KG	5	5	1			0.85	230	48.31	5.94E+00	1.02E+02	2.10E+00	1.45E+02	1.45E+02
BNA	Benzo(b)Fluoranthene	mg/KG	5	5	1			1.9	220	48.1	9.88E+00	9.61E+01	2.00E+00	1.40E+02	1.40E+02
BNA	Benzo(g,h,i)Perylene	mg/KG	5	5	1			0.064	99	20.5008	1.45E+00	4.39E+01	2.14E+00	6.23E+01	6.23E+01
BNA	Benzo(k)Fluoranthene	mg/KG	5	5	1			1.3	160	34.92	7.08E+00	6.99E+01	2.00E+00	1.02E+02	1.02E+02
M-TOTAL	Beryllium	mg/KG	3	5	0.6	0.55	0.68	1.4	4.3	1.603	9.91E-01	1.63E+00	1.02E+00	3.16E+00	3.16E+00
M-TOTAL	Cadmium	mg/KG	5	5	1			0.72	2.5	1.574	1.42E+00	7.51E-01	4.77E-01	2.29E+00	2.29E+00
M-TOTAL	Chromium	mg/KG	5	5	1			11	45.9	27.28	2.45E+01	1.32E+01	4.84E-01	3.99E+01	3.99E+01
BNA	Chrysene	mg/KG	5	5	1			1.1	180	38.64	6.64E+00	7.90E+01	2.05E+00	1.14E+02	1.14E+02
M-TOTAL	Copper	mg/KG	5	5	1			43.8	8440	2043.56	4.73E+02	3.60E+03	1.76E+00	5.48E+03	5.48E+03
CONV	Cyanide, Total	mg/KG	4	5	0.8	0.55	0.55	0.77	3.31	1.679	1.22E+00	1.23E+00	7.32E-01	2.85E+00	2.85E+00
BNA	Dibenzo(a,h)Anthracene	mg/KG	5	5	1			0.17	46	9.76	1.31E+00	2.03E+01	2.08E+00	2.91E+01	2.91E+01
BNA	Fluoranthene	mg/KG	5	5	1			1	280	58.68	7.05E+00	1.24E+02	2.11E+00	1.77E+02	1.77E+02
BNA	Fluorene	mg/KG	1	5	0.2	0.45	1.5	5.7	5.7	1.552	7.71E-01	2.33E+00	1.50E+00	3.77E+00	3.77E+00
CONV	Fluoride, GI Extraction	mg/KG	4	5	0.8	75	75	222	3630	1324.1	4.55E+02	1.63E+03	1.23E+00	2.88E+03	2.88E+03
BNA	Indeno(1,2,3-cd)Pyrene	mg/KG	5	5	1			0.32	130	27.384	3.19E+00	5.74E+01	2.10E+00	8.21E+01	8.21E+01
M-TOTAL	Lead	mg/KG	5	5	1			11.9	68.3	37.48	3.10E+01	2.29E+01	6.12E-01	5.93E+01	5.93E+01
M-TOTAL	Mercury	mg/KG	3	5	0.6	0.08	0.08	0.09	0.3	0.154	1.05E-01	1.35E-01	8.76E-01	2.83E-01	2.83E-01
M-TOTAL	Nickel	mg/KG	5	5	1			17.3	111	57.22	4.57E+01	4.00E+01	6.99E-01	9.54E+01	9.54E+01
BNA	Phenanthrene	mg/KG	5	5	1			0.43	140	29.044	2.81E+00	6.20E+01	2.14E+00	8.82E+01	8.82E+01
BNA	Pyrene	mg/KG	5	5	1			0.85	230	48.13	5.78E+00	1.02E+02	2.11E+00	1.45E+02	1.45E+02
M-TOTAL	Selenium	mg/KG	1	5	0.2	1.1	1.4	2.6	2.6	1.03	8.42E-01	8.79E-01	8.54E-01	1.87E+00	1.87E+00
M-TOTAL	Vanadium	mg/KG	5	5	1			45.9	112	66.94	6.35E+01	2.64E+01	3.95E-01	9.21E+01	9.21E+01
M-TOTAL	Zinc	mg/KG	5	5	1			40.7	146	90.44	8.35E+01	3.82E+01	4.23E-01	1.27E+02	1.27E+02

TABLE A-3
EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION
MAINTENANCE WORKER SCENARIO
North Landfill Composite Surficial Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Surface Soil Concentration (μg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	2,631	9.56E-08	0.34
Arsenic	A	1.50	10,727	2.92E-07	1.03
Benzo(a)Anthracene	B2	0.73	107,390	1.42E-06	5.04
Benzo(a)Pyrene	B2	7.30	145,166	1.93E-05	68.13
Benzo(b)Fluoranthene	B2	0.73	139,748	1.85E-06	6.56
Benzo(k)Fluoranthene	B2	0.073	101,603	1.35E-07	0.48
Beryllium	B2	4.3	3,161	2.47E-07	0.87
Chrysene	B2	0.0073	113,997	1.51E-08	0.05
Dibenzo(a,h)Anthracene	B2	7.3	29,081	3.86E-06	13.65
Indeno(1,2,3-cd)Pyrene	B2	0.73	82,091	1.09E-06	3.85
SUM OF RISKS				**2.8E-05**	

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Maintenance Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Adult	25
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.02

TABLE A-4 EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION MAINTENANCE WORKER SCENARIO North Landfill Composite Surficial Soil Samples					
Chemical	**EPA Carcinogen Classification**	**Cancer Slope Factor (kg-day/mg)**	**Surface Soil Concentration (µg/kg)**	**Excess Lifetime Cancer Risk**	**Percent of Total Risk**
Aroclor 1268	NA	2.0	2,631	1.77E-08	0.34
Arsenic	A	1.50	10,727	5.40E-08	1.03
Benzo(a)Anthracene	B2	0.73	107,390	2.63E-07	5.04
Benzo(a)Pyrene	B2	7.30	145,166	3.56E-06	68.13
Benzo(b)Fluoranthene	B2	0.73	139,748	3.42E-07	6.56
Benzo(k)Fluoranthene	B2	0.073	101,603	2.49E-08	0.48
Beryllium	B2	4.3	3,161	4.56E-08	0.87
Chrysene	B2	0.0073	113,997	2.79E-09	0.05
Dibenzo(a,h)Anthracene	B2	7.3	29,081	7.12E-07	13.65
Indeno(1,2,3-cd)Pyrene	B2	0.73	82,091	2.01E-07	3.85
SUM OF RISKS				**5.2E-06**	

EXPOSURE ASSUMPTIONS		**AVG**
Exposure Setting		Maintenance Worker
Exposure Case		Average
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		12
Number of Years Exposed	- Adult	10
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.00

TABLE A-5
EXCESS LIFETIME CANCER RISK: DERMAL CONTACT WITH SOIL
MAINTENANCE WORKER SCENARIO

North Landfill Composite Surficial Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Percent Dermal Absorption	Surface Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	6%	2.631E+03	1.30E-07	51.54
Arsenic	A	1.5	1%	1.07E+04	6.61E-08	26
Beryllium	B2	4.3	1%	3.16E+03	5.58E-08	22
SUM OF RISKS					**2.5E-07**	

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Maintenance Worker	Averaging Time: Lifetime (yr)	70
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	1130
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Adult	1130
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.00
Number of Years Exposed - Adult	25		

NOTE: Carcinogenic risk of PAHs is addressed in uncertainty discussion in Section 2.4.1.3.

TABLE A-6
NONCANCER HEALTH RISK EVALUATION: SURFACE SOIL INGESTION
MAINTENANCE WORKER SCENARIO
North Landfill Composite Surficial Soil Samples

Chemical	Reference Dose (RfD) mg/kg-day	Surface Soil Concentration (µg/kg)	Estimated Daily Intake (DI) (mg/kg-day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	10,117	5.15E-07	8.6E-06	NO	0.06
Aluminum	1.0	24,196,868	1.23E-03	1.2E-03	NO	7.94
Anthracene	0.3	16,379	8.33E-07	2.8E-06	NO	0.02
Antimony	0.0004	2,793	1.42E-07	3.6E-04	NO	2.29
Arsenic	0.0003	10,727	5.46E-07	1.8E-03	NO	11.73
Barium	0.07	101,381	5.16E-06	7.4E-05	NO	0.48
Beryllium	0.005	3,161	1.61E-07	3.2E-05	NO	0.21
Cadmium	0.001	2,290	1.17E-07	1.2E-04	NO	0.75
Chromium	0.005	39,861	2.03E-06	4.1E-04	NO	2.62
Copper	0.037	5,479,620	2.79E-04	7.5E-03	NO	48.60
Cyanide, Total	0.02	2,851	1.45E-07	7.3E-06	NO	0.05
Fluoranthene	0.04	176,658	8.99E-06	2.2E-04	NO	1.45
Fluorene	0.04	3,771	1.92E-07	4.8E-06	NO	0.03
Fluoride, GI Extraction	0.06	2,878,493	1.46E-04	2.4E-03	NO	15.74
Mercury	0.0003	283	1.44E-08	4.8E-05	NO	0.31
Nickel	0.02	95,384	4.85E-06	2.4E-04	NO	1.57
Pyrene	0.03	145,076	7.38E-06	2.5E-04	NO	1.59
Selenium	0.005	1,868	9.51E-08	1.9E-05	NO	0.12
Vanadium	0.007	92,133	4.69E-06	6.7E-04	NO	4.32
Zinc	0.3	126,892	6.46E-06	2.2E-05	NO	0.14
HAZARD INDEX (Sum of DI/RfD)				**0.016**		

EXPOSURE ASSUMPTIONS		RME
Exposure Setting		Maintenance Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Adult	25
Averaging Time: Lifetime (yr)		25
Lifetime Average Soil Intake (mg/kg body wt./day)		0.05

TABLE A-7 NONCANCER HEALTH RISK EVALUATION: DERMAL CONTACT WITH SOIL MAINTENANCE WORKER SCENARIO North Landfill Composite Surficial Soil Samples							
Chemical	**Reference Dose (RfD) mg/kg/day**	**Percent Dermal Absorption**	**Surface Soil Concentration (µg/kg)**	**Estimated Daily Intake (DI) (mg/kg/day)**	**Hazard Quotient (DI/RfD)**	**Exceed Reference Dose?**	**Percent of Total Risk**
Acenaphthene	0.06	13%	10,117	1.51E-06	2.5E-05	NO	0.53
Aluminum	1.0	1%	24,196,868	2.78E-04	2.8E-04	NO	5.88
Anthracene	0.30	10%	16,379	1.88E-06	6.3E-06	NO	0.13
Antimony	0.0004	1%	2,793	3.21E-08	8.0E-05	NO	1.70
Arsenic	0.0003	1%	10,727	1.23E-07	4.1E-04	NO	8.69
Barium	0.07	1%	101,381	1.17E-06	1.7E-05	NO	0.35
Beryllium	0.005	1%	3,161	3.64E-08	7.3E-06	NO	0.15
Cadmium	0.0010	1%	2,290	2.63E-08	2.6E-05	NO	0.56
Chromium	0.005	0%	39,861	0.00E+00	0.0E+00	NO	<0.01
Copper	0.037	1%	5,479,620	6.30E-05	1.7E-03	NO	36.00
Cyanide, Total	0.02	1%	2,851	3.28E-08	1.6E-06	NO	0.03
Fluoranthene	0.04	13%	176,658	2.64E-05	6.6E-04	NO	13.95
Fluorene	0.04	13%	3,771	5.64E-07	1.4E-05	NO	0.30
Fluoride, GI Extraction	0.06	1%	2,878,493	3.31E-05	5.5E-04	NO	11.66
Mercury	0.0003	1%	283	3.25E-09	1.1E-05	NO	0.23
Nickel	0.02	1%	95,384	1.10E-06	5.5E-05	NO	1.16
Pyrene	0.03	13%	145,076	2.17E-05	7.2E-04	NO	15.28
Selenium	0.005	1%	1,868	2.15E-08	4.3E-06	NO	0.09
Vanadium	0.007	1%	92,133	1.06E-06	1.5E-04	NO	3.20
Zinc	0.30	1%	126,892	1.46E-06	4.9E-06	NO	0.10
HAZARD INDEX (Sum of DI/RfD)					**0.005**		

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Maintenance Worker	Averaging Time: Lifetime (yr)	25
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	1130
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Adult	1130
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.0
Number of Years Exposed - Adult	25		

TABLE A-8 ECOLOGICAL SCREENING North Landfill Composite Surficial Soil Samples		
Chemical	**Ecological Screening Level (µg/kg)**	**Surface Soil Concentration (µg/kg)**
Acenaphthene	192,000	10,117
Aluminum	11,915,000	**24,196,868**
Anthracene	192,000	16,379
Antimony	15,360	2,793
Aroclor 1268	20,600	2,631
Arsenic	29,800	10,727
Barium	2,059,000	101,381
Benzo(a)Anthracene	192,000	107,390
Benzo(a)Pyrene	192,000	145,166
Benzo(b)Fluoranthene	192,000	139,748
Benzo(g,h,i)Perylene	192,000	62,348
Benzo(k)Fluoranthene	192,000	101,603
Beryllium	315,000	3,161
Cadmium	6,910	2,290
Chromium	460,000	39,861
Chrysene	192,000	113,997
Copper	327,000	**5,479,620**
Cyanide, Total	548,000	2,851
Dibenzo(a,h)Anthracene	192,000	29,081
Fluoranthene	192,000	176,658
Fluorine	192,000	3,771
Fluoride, GI Extraction	2,940,000	2,878,493
Indeno(1,2,3-cd)Pyrene	192,000	82,091
Lead	205,000	59,335
Mercury	400	283
Nickel	6,398,000	95,384
Phenanthrene	192,000	88,190
Pyrene	192,000	145,076
Selenium	10,200	1,868
Vanadium	70,800	**92,133**
Zinc	367,000	126,892

NOTE: Shading indicates an exceedance of screening criteria.

TABLE A-9
EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION
MAINTENANCE WORKER SCENARIO
North Landfill Composite Surficial Soil Samples
Maximum Detected Concentration (Minus Transect NL-SB006)

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Surface Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	3,700	1.34E-07	8.69
Arsenic	A	1.50	8,100	2.21E-07	14.27
Benzo(a)Anthracene	B2	0.73	3,300	4.38E-08	2.83
Benzo(a)Pyrene	B2	7.30	5,200	6.90E-07	44.58
Benzo(b)Fluoranthene	B2	0.73	7,700	1.02E-07	6.60
Benzo(k)Fluoranthene	B2	0.073	5,100	6.77E-09	0.44
Beryllium	B2	4.3	1,700	1.33E-07	8.58
Chrysene	B2	0.0073	4,300	5.70E-10	0.04
Dibenzo(a,h)Anthracene	B2	7.3	1,300	1.72E-07	11.14
Indeno(1,2,3-cd)Pyrene	B2	0.73	3,300	4.38E-08	2.83
SUM OF RISKS				**1.5E-06**	

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Maintenance Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Adult	25
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.02

ATTACHMENT B

South Landfill Exposure Assumptions and Risk Calculations

TABLE B-1
EXPOSURE ASSUMPTIONS FOR DIRECT CONTACT RISK EVALUATION
South Landfill Soil

EXPOSURE ASSUMPTIONS	RME	AVG	RME	AVG	RME	AVG
Exposure Setting	Maintenance Worker	Maintenance Worker	Trespasser	Trespasser	Trench Worker	Trench Worker
Exposure Case	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum	Average
Daily Soil Intake (mg/day)	50	50	200	100	480	100
Body Weight (kg)	70	70	35	35	70	70
Number of Days/Week Exposed	1	1	1	1	5	5
Number of Weeks/Year Exposed	26	12	26	4	4	2
Number of Years Exposed	25	10	5	5	7	1
Averaging Time: Cancer (yr)	70	70	70	70	70	70
Averaging Time: Noncancer (yr)	25	10	5	5	7	1
Exposed Body Part(s)	Hands	Hands	Arms, Hands, Legs	Hands	Head, Forearms, Hands	Head, Forearms, Hands
Exposed Skin Surface Area (cm^2)	1130	840	3200	470	4100	3160
Soil Contact Rate (mg/day)	1130	168	3200	94	4100	632
Soil to Skin Adherence Factor (mg/cm^2)	1.00	0.20	1.00	0.20	1.00	0.20

TABLE B-2
SUMMARY STATISTICS: COMPOSITE SURFICIAL SOIL SAMPLES
South Landfill

Data for Composite Surficial Soil Samples Collected in Summer 1997 - South Landfill

Method	Analyte	Units	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Geometric Mean	Standard Deviation	Coefficient of Variation	Upper 95% Confidence-t	RME
BNA	Acenaphthene	mg/KG	10	10	1			0.75	24	5.645	3.39E+00	7.00E+00	1.24E+00	9.70E+00	9.70E+00
M-TOTAL	Aluminum	mg/KG	10	10	1			16600	37200	26900	2.59E+04	7.41E+03	2.75E-01	3.12E+04	3.12E+04
BNA	Anthracene	mg/KG	10	10	1			1.3	50	9.35	5.06E+00	1.46E+01	1.56E+00	1.78E+01	1.78E+01
M-TOTAL	Antimony	mg/KG	6	10	0.6	2.8	3	3.6	6.3	3.345	2.85E+00	1.87E+00	5.60E-01	4.43E+00	4.43E+00
PEST/PCB	Aroclor 1268	mg/KG	9	10	0.9	0.75	0.75	0.54	24	4.2715	2.04E+00	7.12E+00	1.67E+00	8.40E+00	8.40E+00
M-TOTAL	Arsenic	mg/KG	10	10	1			6.1	24.2	14.82	1.36E+01	6.02E+00	4.06E-01	1.83E+01	1.83E+01
M-TOTAL	Barium	mg/KG	10	10	1			52.5	152	104.35	9.95E+01	3.13E+01	3.00E-01	1.22E+02	1.22E+02
BNA	Benzo(a)Anthracene	mg/KG	10	10	1			9.8	330	66.08	3.87E+01	9.52E+01	1.44E+00	1.21E+02	1.21E+02
BNA	Benzo(a)Pyrene	mg/KG	10	10	1			11	370	79.4	4.90E+01	1.06E+02	1.33E+00	1.41E+02	1.41E+02
BNA	Benzo(b)Fluoranthene	mg/KG	10	10	1			21	480	110.5	7.16E+01	1.35E+02	1.23E+00	1.89E+02	1.89E+02
BNA	Benzo(g,h,i)Perylene	mg/KG	10	10	1			6.6	190	40.96	2.59E+01	5.40E+01	1.32E+00	7.23E+01	7.23E+01
BNA	Benzo(k)Fluoranthene	mg/KG	10	10	1			11	290	63.7	4.01E+01	8.26E+01	1.30E+00	1.12E+02	1.12E+02
M-TOTAL	Beryllium	mg/KG	10	10	1			0.68	6	3.058	2.68E+00	1.43E+00	4.67E-01	3.89E+00	3.89E+00
M-TOTAL	Cadmium	mg/KG	10	10	1			1.1	5.2	3.12	2.84E+00	1.28E+00	4.09E-01	3.86E+00	3.86E+00
M-TOTAL	Chromium	mg/KG	10	10	1			25	129	70	6.14E+01	3.61E+01	5.16E-01	9.09E+01	9.09E+01
BNA	Chrysene	mg/KG	10	10	1			14	400	81.9	4.91E+01	1.15E+02	1.40E+00	1.48E+02	1.48E+02
M-TOTAL	Copper	mg/KG	10	10	1			641	5190	2959.1	2.53E+03	1.49E+03	5.02E-01	3.82E+03	3.82E+03
CONV	Cyanide, Total	mg/KG	10	10	1			1.47	7.85	3.617	3.30E+00	1.74E+00	4.82E-01	4.63E+00	4.63E+00
BNA	Dibenzo(a,h)Anthracene	mg/KG	10	10	1			3	71	17.52	1.20E+01	1.97E+01	1.13E+00	2.90E+01	2.90E+01
BNA	Fluoranthene	mg/KG	10	10	1			13	530	97.5	5.21E+01	1.55E+02	1.59E+00	1.87E+02	1.87E+02
BNA	Fluorene	mg/KG	6	10	0.6	3.1	31	0.87	8.8	4.807	3.16E+00	4.65E+00	9.68E-01	7.50E+00	7.50E+00
CONV	Fluoride, GI Extraction	mg/KG	10	10	1			1400	5940	3274	3.05E+03	1.26E+03	3.84E-01	4.00E+03	4.00E+03
BNA	Indeno(1,2,3-cd)Pyrene	mg/KG	10	10	1			7.4	200	46.94	3.13E+01	5.59E+01	1.19E+00	7.94E+01	7.94E+01
M-TOTAL	Lead	mg/KG	10	10	1			63.1	432	195.21	1.70E+02	1.12E+02	5.75E-01	2.60E+02	2.60E+02
M-TOTAL	Mercury	mg/KG	8	10	0.8	0.06	0.06	0.08	0.35	0.135	1.05E-01	9.77E-02	7.23E-01	1.92E-01	1.92E-01
M-TOTAL	Nickel	mg/KG	10	10	1			89.4	286	153.44	1.42E+02	6.58E+01	4.29E-01	1.92E+02	1.92E+02
BNA	Phenanthrene	mg/KG	10	10	1			6.4	230	44.14	2.48E+01	6.69E+01	1.51E+00	8.29E+01	8.29E+01
BNA	Pyrene	mg/KG	10	10	1			11	450	81.3	4.32E+01	1.32E+02	1.62E+00	1.58E+02	1.58E+02
M-TOTAL	Selenium	mg/KG	3	10	0.3	1.1	1.2	1.4	2.7	1.015	8.34E-01	7.67E-01	7.56E-01	1.46E+00	1.46E+00
M-TOTAL	Silver	mg/KG	3	10	0.3	1.1	1.2	1.2	1.9	0.875	7.75E-01	5.06E-01	5.78E-01	1.17E+00	1.17E+00
M-TOTAL	Vanadium	mg/KG	10	10	1			71.3	172	106.46	1.02E+02	3.29E+01	3.09E-01	1.26E+02	1.26E+02
M-TOTAL	Zinc	mg/KG	10	10	1			48.1	261	166	1.49E+02	6.85E+01	4.13E-01	2.06E+02	2.06E+02

TABLE B-3 EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION MAINTENANCE WORKER SCENARIO South Landfill Composite Surficial Soil Samples					
Chemical	**EPA Carcinogen Classification**	**Cancer Slope Factor (kg-day/mg)**	**Surface Soil Concentration (µg/kg)**	**Excess Lifetime Cancer Risk**	**Percent of Total Risk**
Aroclor 1268	NA	2.0	8,396	3.05E-07	1.05
Arsenic	A	1.5	18,311	4.99E-07	1.73
Benzo(a)Anthracene	B2	0.73	121,260	1.61E-06	5.56
Benzo(a)Pyrene	B2	7.30	140,566	1.86E-05	64.45
Benzo(b)Fluoranthene	B2	0.73	189,009	2.51E-06	8.67
Benzo(k)Fluoranthene	B2	0.073	111,559	1.48E-07	0.51
Beryllium	B2	4.30	3,886	3.04E-07	1.05
Chrysene	B2	0.0073	148,473	1.97E-08	0.07
Dibenzo(a,h)Anthracene	B2	7.30	28,959	3.84E-06	13.28
Indeno(1,2,3-cd)Pyrene	B2	0.73	79,370	1.05E-06	3.64
SUM OF RISKS				**2.9E-05**	

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Maintenance Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Adult	25
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.02

TABLE B-4
EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION
MAINTENANCE WORKER SCENARIO
South Landfill Composite Surficial Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Surface Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	8,396	5.63E-08	1.05
Arsenic	A	1.5	18,311	9.21E-08	1.73
Benzo(a)Anthracene	B2	0.73	121,260	2.97E-07	5.56
Benzo(a)Pyrene	B2	7.30	140,566	3.44E-06	64.45
Benzo(b)Fluoranthene	B2	0.73	189,009	4.63E-07	8.67
Benzo(k)Fluoranthene	B2	0.073	111,559	2.73E-08	0.51
Beryllium	B2	4.30	3,886	5.61E-08	1.05
Chrysene	B2	0.0073	148,473	3.64E-09	0.07
Dibenzo(a,h)Anthracene	B2	7.30	28,959	7.09E-07	13.28
Indeno(1,2,3-cd)Pyrene	B2	0.73	79,370	1.94E-07	3.64
SUM OF RISKS				**5.3E-06**	

EXPOSURE ASSUMPTIONS		**AVG**
Exposure Setting		Maintenance Worker
Exposure Case		Average
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		12
Number of Years Exposed	- Adult	10
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.00

TABLE B-5
NONCANCER HEALTH RISK EVALUATION: SURFACE SOIL INGESTION
MAINTENANCE WORKER SCENARIO
South Landfill Composite Surficial Soil Samples

Chemical	Reference Dose (RfD) mg/kg-day	Surface Soil Concentration (µg/kg)	Estimated Daily Intake (DI) (mg/kg-day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	9,704	4.94E-07	8.2E-06	NO	0.05
Aluminum	1	31,193,470	1.59E-03	1.6E-03	NO	9.23
Anthracene	0.3	17,820	9.07E-07	3.0E-06	NO	0.02
Antimony	0.0004	4,431	2.25E-07	5.6E-04	NO	3.28
Arsenic	0.0003	18,311	9.32E-07	3.1E-03	NO	18.07
Barium	0.07	122,472	6.23E-06	8.9E-05	NO	0.52
Beryllium	0.005	3,886	1.98E-07	4.0E-05	NO	0.23
Cadmium	0.001	3,860	1.96E-07	2.0E-04	NO	1.14
Chromium	0.005	90,937	4.63E-06	9.3E-04	NO	5.38
Copper	0.037	3,821,037	1.94E-04	5.3E-03	NO	30.57
Cyanide, Total	0.02	4,627	2.35E-07	1.2E-05	NO	0.07
Fluoranthene	0.04	187,398	9.53E-06	2.4E-04	NO	1.39
Fluorene	0.04	7,504	3.82E-07	9.5E-06	NO	0.06
Fluoride, GI Extraction	0.06	4,002,921	2.04E-04	3.4E-03	NO	19.75
Mercury	*0.0003*	*192*	*9.75E-09*	*3.2E-05*	*NO*	*0.19*
Nickel	0.02	191,554	9.75E-06	4.9E-04	NO	2.84
Pyrene	0.03	157,748	8.03E-06	2.7E-04	NO	1.56
Selenium	0.005	1,460	7.43E-08	1.5E-05	NO	0.09
Silver	0.005	1,168	5.94E-08	1.2E-05	NO	0.07
Vanadium	0.007	125,530	6.39E-06	9.1E-04	NO	5.31
Zinc	0.3	205,700	1.05E-05	3.5E-05	NO	0.20
HAZARD INDEX (Sum of DI/RfD)				**0.017**		

EXPOSURE ASSUMPTIONS		RME
Exposure Setting		Maintenance Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	50
Body Weight (kg)	- Adult	70
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Adult	25
Averaging Time: Lifetime (yr)		25
Lifetime Average Soil Intake (mg/kg body wt./day)		0.05

TABLE B-6
EXCESS LIFETIME CANCER RISK: DERMAL CONTACT WITH SOIL
MAINTENANCE WORKER SCENARIO

South Landfill Composite Surficial Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Percent Dermal Absorption	Surface Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	6%	8.396E+03	4.14E-07	69.52
Arsenic	A	1.5	1%	1.83E+04	1.13E-07	19
Beryllium	B2	4.3	1%	3.89E+03	6.86E-08	12
SUM OF RISKS					**6.0E-07**	

EXPOSURE ASSUMPTIONS			RME
Exposure Setting	Maintenance Worker	Averaging Time: Lifetime (yr)	70
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	1130
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Adult	1130
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.00
Number of Years Exposed - Adult	25		

NOTE: Carcinogenic risk of PAHs is addressed in uncertainty discussion in Section 3.3.1.3.

TABLE B-7
NONCANCER HEALTH RISK EVALUATION: DERMAL CONTACT WITH SOIL
MAINTENANCE WORKER SCENARIO
South Landfill Composite Surficial Soil Samples

Chemical	Reference Dose (RfD) mg/kg/day	Percent Dermal Absorption	Surface Soil Concentration µg/kg)	Estimated Daily Intake (DI) (mg/kg/day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	13%	9,704	1.45E-06	2.4E-05	NO	0.47
Aluminum	1.0	1%	31,193,470	3.59E-04	3.6E-04	NO	7.03
Anthracene	0.30	10%	17,820	2.05E-06	6.8E-06	NO	0.13
Antimony	0.0004	1%	4,431	5.10E-08	1.3E-04	NO	2.50
Arsenic	0.0003	1%	18,311	2.11E-07	7.0E-04	NO	13.76
Barium	0.07	1%	122,472	1.41E-06	2.0E-05	NO	0.39
Beryllium	0.005	1%	3,886	4.47E-08	8.9E-06	NO	0.18
Cadmium	0.001	1%	3,860	4.44E-08	4.4E-05	NO	0.87
Chromium	0.005	0%	90,937	0.00E+00	0.0E+00	NO	<0.01
Copper	0.037	1%	3,821,037	4.39E-05	1.2E-03	NO	23.28
Cyanide, Total	0.02	1%	4,627	5.32E-08	2.7E-06	NO	0.05
Fluoranthene	0.04	13%	187,398	2.80E-05	7.0E-04	NO	13.73
Fluorene	0.04	13%	7,504	1.12E-06	2.8E-05	NO	0.55
Fluoride, GI Extraction	0.06	1%	4,002,921	4.60E-05	7.7E-04	NO	15.04
Mercury	0.0003	1%	192	2.20E-09	7.3E-06	NO	0.14
Nickel	0.02	1%	191,554	2.20E-06	1.1E-04	NO	2.16
Pyrene	0.03	13%	157,748	2.36E-05	7.9E-04	NO	15.41
Selenium	0.005	1%	1,460	1.68E-08	3.4E-06	NO	0.07
Silver	0.005	1%	1,168	1.34E-08	2.7E-06	NO	0.05
Vanadium	0.007	1%	125,530	1.44E-06	2.1E-04	NO	4.04
Zinc	0.30	1%	205,700	2.37E-06	7.9E-06	NO	0.15
HAZARD INDEX (Sum of DI/RfD)					**0.005**		

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Maintenance Worker	Averaging Time: Lifetime (yr)	25
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	1130
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Adult	1130
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.0
Number of Years Exposed - Adult	25		

TABLE B-8 EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION TRESPASSER SCENARIO South Landfill Composite Surficial Soil Samples					
Chemical	**EPA Carcinogen Classification**	**Cancer Slope Factor (kg-day/mg)**	**Surface Soil Concentration (μg/kg)**	**Excess Lifetime Cancer Risk**	**Percent of Total Risk**
Aroclor 1268	NA	2.0	8,396	4.88E-07	1.05
Arsenic	A	1.5	18,311	7.99E-07	1.73
Benzo(a)Anthracene	B2	0.73	121,260	2.57E-06	5.56
Benzo(a)Pyrene	B2	7.30	140,566	2.98E-05	64.45
Benzo(b)Fluoranthene	B2	0.73	189,009	4.01E-06	8.67
Benzo(k)Fluoranthene	B2	0.073	111,559	2.37E-07	0.51
Beryllium	B2	4.30	3,886	4.86E-07	1.05
Chrysene	B2	0.0073	148,473	3.15E-08	0.07
Dibenzo(a,h)Anthracene	B2	7.30	28,959	6.15E-06	13.28
Indeno(1,2,3-cd)Pyrene	B2	0.73	79,370	1.68E-06	3.64
SUM OF RISKS				**4.6E-05**	

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Trespasser
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Child	200
Body Weight (kg)	- Child	35
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Child	5
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.03

TABLE B-9
EXCESS LIFETIME CANCER RISK: SURFACE SOIL INGESTION
TRESPASSER SCENARIO
South Landfill Composite Surficial Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Surface Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1268	NA	2.0	8,396	3.76E-08	1.05
Arsenic	A	1.5	18,311	6.14E-08	1.73
Benzo(a)Anthracene	B2	0.73	121,260	1.98E-07	5.56
Benzo(a)Pyrene	B2	7.30	140,566	2.29E-06	64.45
Benzo(b)Fluoranthene	B2	0.73	189,009	3.09E-07	8.67
Benzo(k)Fluoranthene	B2	0.073	111,559	1.82E-08	0.51
Beryllium	B2	4.30	3,886	3.74E-08	1.05
Chrysene	B2	0.0073	148,473	2.42E-09	0.07
Dibenzo(a,h)Anthracene	B2	7.30	28,959	4.73E-07	13.28
Indeno(1,2,3-cd)Pyrene	B2	0.73	79,370	1.30E-07	3.64
SUM OF RISKS				**3.6E-06**	

EXPOSURE ASSUMPTIONS		**AVG**
Exposure Setting		Trespasser
Exposure Case		Average
Daily Soil Intake (mg/day)	- Child	100
Body Weight (kg)	- Child	35
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		4
Number of Years Exposed	- Child	5
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.002

TABLE B-10
NONCANCER HEALTH RISK EVALUATION: SURFACE SOIL INGESTION
TRESPASSER SCENARIO

South Landfill Composite Surficial Soil Samples

Chemical	Reference Dose (RfD) mg/kg-day	Surface Soil Concentration (μg/kg)	Estimated Daily Intake (DI) (mg/kg-day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	9,704	3.95E-06	6.6E-05	NO	0.05
Aluminum	1	31,193,470	1.27E-02	1.3E-02	NO	9.23
Anthracene	0.3	17,820	7.25E-06	2.4E-05	NO	0.02
Antimony	0.0004	4,431	1.80E-06	4.5E-03	NO	3.28
Arsenic	0.0003	18,311	7.45E-06	2.5E-02	NO	18.07
Barium	0.07	122,472	4.99E-05	7.1E-04	NO	0.52
Beryllium	0.005	3,886	1.58E-06	3.2E-04	NO	0.23
Cadmium	0.001	3,860	1.57E-06	1.6E-03	NO	1.14
Chromium	0.005	90,937	3.70E-05	7.4E-03	NO	5.38
Copper	0.037	3,821,037	1.56E-03	4.2E-02	NO	30.57
Cyanide, Total	0.02	4,627	1.88E-06	9.4E-05	NO	0.07
Fluoranthene	0.04	187,398	7.63E-05	1.9E-03	NO	1.39
Fluorene	0.04	7,504	3.05E-06	7.6E-05	NO	0.06
Fluoride, GI Extraction	0.06	4,002,921	1.63E-03	2.7E-02	NO	19.75
Mercury	0.0003	192	7.80E-08	2.6E-04	NO	0.19
Nickel	0.02	191,554	7.80E-05	3.9E-03	NO	2.84
Pyrene	0.03	157,748	6.42E-05	2.1E-03	NO	1.56
Selenium	0.005	1,460	5.94E-07	1.2E-04	NO	0.09
Silver	0.005	1,168	4.75E-07	9.5E-05	NO	0.07
Vanadium	0.007	125,530	5.11E-05	7.3E-03	NO	5.31
Zinc	0.3	205,700	8.37E-05	2.8E-04	NO	0.20
HAZARD INDEX (Sum of DI/RfD)				**0.138**		

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Trespasser
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Child	200
Body Weight (kg)	- Child	35
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Child	5
Averaging Time: Lifetime (yr)		5
Lifetime Average Soil Intake (mg/kg body wt./day)		0.41

TABLE B-11 EXCESS LIFETIME CANCER RISK: DERMAL CONTACT WITH SOIL TRESPASSER SCENARIO South Landfill Composite Surficial Soil Samples						
Chemical	**EPA Carcinogen Classification**	**Cancer Slope Factor (kg-day/mg)**	**Percent Dermal Absorption**	**Surface Soil Concentration (µg/kg)**	**Excess Lifetime Cancer Risk**	**Percent of Total Risk**
Aroclor 1268	NA	2.0	6%	8.396E+03	4.69E-07	69.52
Arsenic	A	1.5	1%	1.83E+04	1.28E-07	19
Beryllium	B2	4.3	1%	3.89E+03	7.77E-08	12
SUM OF RISKS					**6.7E-07**	

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Trespasser	Averaging Time: Lifetime (yr)	35
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Arms, Hands, Legs
Body Weight (kg) - Child	35	Exposed Skin Surface Area - Child (cm^2)	3200
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Child	3200
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.00
Number of Years Exposed - Child	5		

NOTE: Carcinogenic risk of PAHs is addressed in uncertainty discussion in Section 3.3.1.3.

TABLE B-12
NONCANCER HEALTH RISK EVALUATION: DERMAL CONTACT WITH SOIL
TRESPASSER SCENARIO
South Landfill Composite Surficial Soil Samples

Chemical	Reference Dose (RfD) mg/kg/day	Percent Dermal Absorption	Surface Soil Concentration (µg/kg)	Estimated Daily Intake (DI) (mg/kg/day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	13%	9,704	8.22E-06	1.4E-04	NO	0.47
Aluminum	1.0	1%	31,193,470	2.03E-03	2.0E-03	NO	7.03
Anthracene	0.30	10%	17,820	1.16E-05	3.9E-05	NO	0.13
Antimony	0.0004	1%	4,431	2.89E-07	7.2E-04	NO	2.50
Arsenic	0.0003	1%	18,311	1.19E-06	4.0E-03	NO	13.76
Barium	0.07	1%	122,472	7.98E-06	1.1E-04	NO	0.39
Beryllium	0.005	1%	3,886	2.53E-07	5.1E-05	NO	0.18
Cadmium	0.001	1%	3,860	2.51E-07	2.5E-04	NO	0.87
Chromium	0.005	0%	90,937	0.00E+00	0.0E+00	NO	<0.01
Copper	0.037	1%	3,821,037	2.49E-04	6.7E-03	NO	23.28
Cyanide, Total	0.02	1%	4,627	3.01E-07	1.5E-05	NO	0.05
Fluoranthene	0.04	13%	187,398	1.59E-04	4.0E-03	NO	13.73
Fluorene	0.04	13%	7,504	6.35E-06	1.6E-04	NO	0.55
Fluoride, GI Extraction	0.06	1%	4,002,921	2.61E-04	4.3E-03	NO	15.04
Mercury	0.0003	1%	192	1.25E-08	4.2E-05	NO	0.14
Nickel	0.02	1%	191,554	1.25E-05	6.2E-04	NO	2.16
Pyrene	0.03	13%	157,748	1.34E-04	4.5E-03	NO	15.41
Selenium	0.005	1%	1,460	9.51E-08	1.9E-05	NO	0.07
Silver	0.005	1%	1,168	7.61E-08	1.5E-05	NO	0.05
Vanadium	0.007	1%	125,530	8.18E-06	1.2E-03	NO	4.04
Zinc	0.30	1%	205,700	1.34E-05	4.5E-05	NO	0.15
HAZARD INDEX (Sum of DI/RfD)					**0.029**		

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Trespasser	Averaging Time: Lifetime (yr)	5
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Arms, Hands, Legs
Body Weight (kg) - Child	35	Exposed Skin Surface Area - Child (cm^2)	3200
Number of Days/Week Exposed	1	Soil Contact Rate (mg/day) - Child	3200
Number of Weeks/Year Exposed	26	Soil to Skin Adherence Factor (mg/cm^2)	1.0
Number of Years Exposed - Child	5		

TABLE B-13 ECOLOGICAL SCREENING South Landfill Composite Surficial Soil Samples		
Chemical	**Ecological Screening Level (µg/kg)**	**Surface Soil Concentration (µg/kg)**
Acenaphthene	192,000	9,704
Aluminum	11,915,000	**31,193,470**
Anthracene	192,000	17,820
Antimony	15,360	4,431
Aroclor 1268	20,600	8,396
Arsenic	29,800	18,311
Barium	2,059,000	122,472
Benzo(a)Anthracene	192,000	121,260
Benzo(a)Pyrene	192,000	140,566
Benzo(b)Fluoranthene	192,000	189,009
Benzo(g,h,i)Perylene	192,000	72,253
Benzo(k)Fluoranthene	192,000	111,559
Beryllium	315,000	3,886
Cadmium	6,910	3,860
Chromium	460,000	90,937
Chrysene	192,000	148,473
Copper	327,000	**3,821,037**
Cyanide, Total	548,000	4,627
Dibenzo(a,h)Anthracene	192,000	28,959
Fluoranthene	192,000	187,398
Fluorene	192,000	7,504
Fluoride, GI Extraction	2,940,000	**4,002,921**
Indeno(1,2,3-cd)Pyrene	192,000	79,370
Lead	205,000	**260,228**
Mercury	400	192
Nickel	6,398,000	191,554
Phenanthrene	192,000	82,897
Pyrene	192,000	157,748
Selenium	10,200	1,460
Silver		1,168
Vanadium	70,800	**125,530**
Zinc	367,000	205,700

NOTE: Shading indicates an exceedance of screening criteria.

TABLE B-14
SUMMARY STATISTICS: SOUTH LANDFILL
Soil Samples

Report class	Analyte	Units	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	Arithmetic Mean	Geometric Mean	Standard Deviation	Coefficient of Variation	Upper 95% Confidence - t
PAH	Acenaphthene	mg/kg	18	24	0.75	0.0067	1.1	0.095	24	2.99E+00	4.15E-01	5.32E+00	1.78E+00	4.85E+00
PAH	Acenaphthylene	mg/kg	2	24	0.08	0.0067	73	0.028	0.33	3.89E+00	2.20E-01	8.00E+00	2.06E+00	6.69E+00
M-TOTAL	Aluminum	mg/kg	10	10	1.00			16600	37200	2.69E+04	2.59E+04	7.41E+03	2.75E-01	3.12E+04
PAH	Anthracene	mg/kg	19	24	0.79	0.0067	0.0067	0.38	50	5.69E+00	7.84E-01	1.07E+01	1.89E+00	9.45E+00
M-TOTAL	Antimony	mg/kg	14	25	0.56	2.5	3	3.2	31	5.81E+00	3.27E+00	8.09E+00	1.39E+00	8.58E+00
PEST/PCB	Aroclor 1248	mg/kg	1	16	0.06	0.05	3.9	0.77	0.77	5.26E-01	2.28E-01	5.35E-01	1.02E+00	7.61E-01
PEST/PCB	Aroclor 1260	mg/kg	2	16	0.13	0.05	3.9	0.21	1.7	5.96E-01	2.73E-01	5.99E-01	1.01E+00	8.58E-01
PEST/PCB	Aroclor 1268	mg/kg	9	10	0.90	0.75	0.75	0.54	24	4.27E+00	2.04E+00	7.12E+00	1.67E+00	8.40E+00
M-TOTAL	Arsenic	mg/kg	22	25	0.88	1	1	1.3	24.2	9.70E+00	6.23E+00	7.04E+00	7.26E-01	1.21E+01
M-TOTAL	Barium	mg/kg	10	10	1.00			52.5	152	1.04E+02	9.95E+01	3.13E+01	3.00E-01	1.22E+02
PAH	Benzo(a)Anthracene	mg/kg	20	24	0.83	0.0067	0.0067	0.065	330	4.34E+01	4.73E+00	7.19E+01	1.66E+00	6.86E+01
PAH	Benzo(a)Pyrene	mg/kg	20	24	0.83	0.0067	0.0067	0.081	370	4.39E+01	4.87E+00	7.64E+01	1.74E+00	7.06E+01
PAH	Benzo(b)Fluoranthene	mg/kg	22	24	0.92	0.0067	0.0067	0.0078	480	6.85E+01	8.33E+00	1.03E+02	1.50E+00	1.05E+02
PAH	Benzo(g,h,i)Perylene	mg/kg	19	23	0.83	0.0067	0.0067	0.096	340	3.80E+01	3.60E+00	7.69E+01	2.02E+00	6.56E+01
PAH	Benzo(k)Fluoranthene	mg/kg	18	24	0.75	0.0067	0.14	0.052	290	3.18E+01	2.32E+00	5.98E+01	1.88E+00	5.27E+01
M-TOTAL	Beryllium	mg/kg	17	25	0.68	1	1	0.68	9.1	2.93E+00	1.87E+00	2.51E+00	8.58E-01	3.79E+00
M-TOTAL	Cadmium	mg/kg	18	25	0.72	1	1	1.1	5.2	2.24E+00	1.65E+00	1.52E+00	6.81E-01	2.76E+00
M-TOTAL	Chromium	mg/kg	25	25	1.00			4.5	220	5.63E+01	3.95E+01	4.82E+01	8.56E-01	7.28E+01
PAH	Chrysene	mg/kg	21	24	0.88	0.0067	0.0067	0.01	400	5.67E+01	6.37E+00	9.42E+01	1.66E+00	8.97E+01
M-TOTAL	Copper	mg/kg	25	25	1.00			80	36000	3.81E+03	1.69E+03	6.99E+03	1.84E+00	6.20E+03
CONV	Cyanide, Total	mg/Kg	25	26	0.96	0.1	0.1	0.29	44	4.52E+00	2.11E+00	8.33E+00	1.84E+00	7.31E+00
PAH	Dibenzo(a,h)Anthracene	mg/kg	20	24	0.83	0.0067	0.0067	0.021	71	9.48E+00	1.46E+00	1.48E+01	1.56E+00	1.47E+01
PAH	Fluoranthene	mg/kg	21	24	0.88	0.0067	0.0067	0.013	530	6.44E+01	6.56E+00	1.15E+02	1.79E+00	1.05E+02
PAH	Fluorene	mg/kg	12	24	0.50	0.0067	31	0.14	8.8	2.41E+00	3.16E-01	3.82E+00	1.59E+00	3.74E+00
CONV	Fluoride, GI Extraction	mg/kg	10	10	1.00			1400	5940	3.27E+03	3.05E+03	1.26E+03	3.84E-01	4.00E+03
PAH	Indeno(1,2,3-cd)Pyrene	mg/kg	20	24	0.83	0.0067	0.0067	0.092	200	2.68E+01	3.69E+00	4.16E+01	1.55E+00	4.14E+01
M-TOTAL	Lead	mg/kg	22	25	0.88	10	10	19	520	1.38E+02	7.63E+01	1.38E+02	9.96E-01	1.86E+02
M-TOTAL	Mercury	mg/kg	9	25	0.36	0.06	0.25	0.08	0.82	1.52E-01	1.20E-01	1.52E-01	1.00E+00	2.04E-01
PAH	Naphthalene	mg/kg	6	24	0.25	0.0067	73	0.056	3.4	4.05E+00	3.49E-01	7.95E+00	1.96E+00	6.83E+00
M-TOTAL	Nickel	mg/kg	25	25	1.00			3.3	290	1.16E+02	7.82E+01	7.92E+01	6.81E-01	1.43E+02
PAH	Phenanthrene	mg/kg	21	24	0.88	0.0067	0.0067	0.01	230	2.69E+01	3.03E+00	4.97E+01	1.84E+00	4.43E+01
PAH	Pyrene	mg/kg	21	24	0.88	0.0067	0.0067	0.014	450	5.90E+01	6.21E+00	1.04E+02	1.77E+00	9.54E+01
M-TOTAL	Selenium	mg/kg	3	24	0.13	1	1.2	1.4	2.7	7.15E-01	6.19E-01	5.45E-01	7.63E-01	9.05E-01
M-TOTAL	Silver	mg/kg	3	25	0.12	1	1.2	1.2	1.9	6.50E-01	5.96E-01	3.62E-01	5.57E-01	7.74E-01
M-TOTAL	Vanadium	mg/kg	10	10	1.00			71.3	172	1.06E+02	1.02E+02	3.29E+01	3.09E-01	1.26E+02
M-TOTAL	Zinc	mg/kg	25	25	1.00			14	850	1.73E+02	1.09E+02	1.81E+02	1.05E+00	2.35E+02

TABLE B-15
EXCESS LIFETIME CANCER RISK: SOIL INGESTION
TRENCH WORKER SCENARIO
South Landfill Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1248	B2	2.0	761	5.72E-08	0.18
Aroclor 1260	B2	2.0	858	6.45E-08	0.20
Aroclor 1268	B2	2.0	8,396	6.31E-07	2.00
Arsenic	A	1.5	12,114	6.83E-07	2.17
Benzo(a)Anthracene	B2	0.73	68,568	1.88E-06	5.97
Benzo(a)Pyrene	B2	7.3	70,582	1.94E-05	61.50
Benzo(b)Fluoranthene	B2	0.73	104,536	2.87E-06	9.11
Benzo(k)Fluoranthene	B2	0.073	52,747	1.45E-07	0.46
Beryllium	B2	4.3	3,792	6.13E-07	1.95
Chrysene	B2	0.0073	89,654	2.46E-08	0.08
Dibenzo(a,h)Anthracene	B2	7.3	14,653	4.02E-06	12.77
Indeno(1,2,3-cd)Pyrene	B2	0.73	41,366	1.13E-06	3.60
SUM OF RISKS				**3.1E-05**	

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Trench Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	480
Body Weight (kg)	- Adult	70
Number of Days/Year Exposed		20
Number of Years Exposed	- Adult	7
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.04

TABLE B-16 EXCESS LIFETIME CANCER RISK: SOIL INGESTION TRENCH WORKER SCENARIO South Landfill Soil Samples					
Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Soil Concentration (µg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1248	B2	2.0	761	8.51E-10	0.18
Aroclor 1260	B2	2.0	858	9.60E-10	0.20
Aroclor 1268	B2	2.0	8,396	9.39E-09	2.00
Arsenic	A	1.5	12,114	1.02E-08	2.17
Benzo(a)Anthracene	B2	0.73	68,568	2.80E-08	5.97
Benzo(a)Pyrene	B2	7.3	70,582	2.88E-07	61.50
Benzo(b)Fluoranthene	B2	0.73	104,536	4.27E-08	9.11
Benzo(k)Fluoranthene	B2	0.073	52,747	2.15E-09	0.46
Beryllium	B2	4.3	3,792	9.12E-09	1.95
Chrysene	B2	0.0073	89,654	3.66E-10	0.08
Dibenzo(a,h)Anthracene	B2	7.3	14,653	5.98E-08	12.77
Indeno(1,2,3-cd)Pyrene	B2	0.73	41,366	1.69E-08	3.60
SUM OF RISKS				**4.7E-07**	

EXPOSURE ASSUMPTIONS		**AVG**
Exposure Setting		Trench Worker
Exposure Case		Average
Daily Soil Intake (mg/day)	- Adult	100
Body Weight (kg)	- Adult	70
Number of Days/Year Exposed		10
Number of Years Exposed	- Adult	1
Averaging Time: Lifetime (yr)		70
Lifetime Average Soil Intake (mg/kg body wt./day)		0.0006

TABLE B-17
NONCANCER HEALTH RISK EVALUATION: SURFACE SOIL INGESTION
TRENCH WORKER SCENARIO

South Landfill Soil Samples

Chemical	Reference Dose (RfD) mg/kg-day	Soil Concentration (µg/kg)	Estimated Daily Intake (DI) (mg/kg-day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	4,853	1.82E-06	3.0E-05	NO	0.02
Aluminum	1.0	31,193,470	1.17E-02	1.2E-02	NO	8.20
Anthracene	0.30	9,452	3.55E-06	1.2E-05	NO	<0.01
Antimony	0.0004	8,581	3.22E-06	8.1E-03	NO	5.64
Arsenic	0.0003	12,114	4.55E-06	1.5E-02	NO	10.61
Barium	0.07	122,472	4.60E-05	6.6E-04	NO	0.46
Beryllium	0.005	3,792	1.42E-06	2.8E-04	NO	0.20
Cadmium	0.001	2,757	1.04E-06	1.0E-03	NO	0.72
Chromium	0.005	72,850	2.74E-05	5.5E-03	NO	3.83
Copper	0.037	6,197,418	2.33E-03	6.3E-02	NO	44.03
Cyanide, Total	0.02	7,307	2.75E-06	1.4E-04	NO	0.10
Fluoranthene	0.04	104,768	3.94E-05	9.8E-04	NO	0.69
Fluorene	0.04	3,743	1.41E-06	3.5E-05	NO	0.02
Fluoride, GI Extraction	0.06	4,002,921	1.50E-03	2.5E-02	NO	17.54
Mercury	0.0003	204	7.66E-08	2.6E-04	NO	0.18
Naphthalene	0.040	3,400	1.28E-06	3.2E-05	NO	0.02
Nickel	0.02	143,352	5.39E-05	2.7E-03	NO	1.88
Pyrene	0.03	95,415	3.59E-05	1.2E-03	NO	0.84
Selenium	0.005	905	3.40E-07	6.8E-05	NO	0.05
Silver	0.005	774	2.91E-07	5.8E-05	NO	0.04
Vanadium	0.007	125,530	4.72E-05	6.7E-03	NO	4.71
Zinc	0.30	234,725	8.82E-05	2.9E-04	NO	0.21
HAZARD INDEX (Sum of DI/RfD)				**0.14**		

EXPOSURE ASSUMPTIONS		**RME**
Exposure Setting		Trench Worker
Exposure Case		Reasonable Maximum
Daily Soil Intake (mg/day)	- Adult	480
Body Weight (kg)	- Adult	70
Number of Days/Year Exposed		20
Number of Years Exposed	- Adult	7
Averaging Time: Lifetime (yr)		7
Lifetime Average Soil Intake (mg/kg body wt./day)		0.38

TABLE B-18
EXCESS LIFETIME CANCER RISK: DERMAL CONTACT WITH SOIL
TRENCH WORKER SCENARIO
South Landfill Soil Samples

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Percent Dermal Absorption	Soil Concentration (μg/kg)	Excess Lifetime Cancer Risk	Percent of Total Risk
Aroclor 1248	B2	2.0	6%	7.61E+02	2.93E-08	6
Aroclor 1260	B2	2.0	6%	8.58E+02	3.31E-08	7
Aroclor 1268	B2	2.0	6%	8.40E+03	3.23E-07	65
Arsenic	A	1.5	1%	1.21E+04	5.83E-08	12
Beryllium	B2	4.3	1%	3.79E+03	5.23E-08	11
SUM OF RISKS					**5.0E-07**	

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Trench Worker	Averaging Time: Lifetime (yr)	70
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Head, Forearms, Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	4100
Number of Days/Year Exposed	20	Soil Contact Rate (mg/day) - Adult	4100
Number of Years Exposed - Adult	7	Soil to Skin Adherence Factor (mg/cm^2)	1.00

NOTE: Carcinogenic risk of PAHs is addressed in uncertainty discussion in Section 3.3.1.3.

TABLE B-19
NONCANCER HEALTH RISK EVALUATION: DERMAL CONTACT WITH SOIL
TRENCH WORKER SCENARIO

South Landfill Soil Samples

Chemical	Reference Dose (RfD) mg/kg/day	Percent Dermal Absorption	Soil Concentration (µg/kg)	Estimated Daily Intake (DI) (mg/kg/day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Acenaphthene	0.06	13%	4,853	2.02E-06	3.4E-05	NO	0.23
Aluminum	1.0	1%	31,193,470	1.00E-03	1.0E-03	NO	6.88
Anthracene	0.30	10%	9,452	3.03E-06	1.0E-05	NO	0.07
Antimony	0.0004	1%	8,581	2.75E-07	6.9E-04	NO	4.73
Arsenic	0.0003	1%	12,114	3.89E-07	1.3E-03	NO	8.91
Barium	0.07	1%	122,472	3.93E-06	5.6E-05	NO	0.39
Beryllium	0.005	1%	3,792	1.22E-07	2.4E-05	NO	0.17
Cadmium	0.001	1%	2,757	8.85E-08	8.8E-05	NO	0.61
Chromium	0.005	1%	72,850	2.34E-06	4.7E-04	NO	3.21
Copper	0.037	1%	6,197,418	1.99E-04	5.4E-03	NO	36.94
Cyanide, Total	0.02	1%	7,307	2.34E-07	1.2E-05	NO	0.08
Fluoranthene	0.04	13%	104,768	4.37E-05	1.1E-03	NO	7.51
Fluorene	0.04	13%	3,743	1.56E-06	3.9E-05	NO	0.27
Fluoride, GI Extraction	0.06	1%	4,002,921	1.28E-04	2.1E-03	NO	14.71
Mercury	0.0003	1%	204	6.54E-09	2.2E-05	NO	0.15
Naphthalene	0.040	13%	3,400	1.42E-06	3.5E-05	NO	0.24
Nickel	0.02	1%	143,352	4.60E-06	2.3E-04	NO	1.58
Pyrene	0.03	13%	95,415	3.98E-05	1.3E-03	NO	9.12
Selenium	0.005	1%	905	2.91E-08	5.8E-06	NO	0.04
Silver	0.005	1%	774	2.48E-08	5.0E-06	NO	0.03
Vanadium	0.007	1%	125,530	4.03E-06	5.8E-04	NO	3.95
Zinc	0.30	1%	234,725	7.53E-06	2.5E-05	NO	0.17
HAZARD INDEX (Sum of DI/RfD)					**0.015**		

EXPOSURE ASSUMPTIONS			**RME**
Exposure Setting	Trench Worker	Averaging Time: Lifetime (yr)	7
Exposure Case	Reasonable Maximum	Exposed Body Part(s)	Head, Forearms, Hands
Body Weight (kg) - Adult	70	Exposed Skin Surface Area - Adult (cm^2)	4100
Number of Days/Year Exposed	20	Soil Contact Rate (mg/day) - Adult	4100
Number of Years Exposed - Adult	7	Soil to Skin Adherence Factor (mg/cm^2)	1.0

Table B-20
Surface Water Data for South Landfill Depression
Reynolds Aluminum

Analyte	SL-SW01 4/28/97	SL-SW02 5/9/97	Maximum Detected Concentration (mg/L)
Aluminum, Dissolved	5.44	6.26	6.26
Aluminum, Total	5.4	5.61	5.61
Beryllium, Dissolved	0.0046	0.0059	0.0059
Beryllium, Total	0.0049	0.0054	0.0054
Copper, Dissolved	0.0268	0.022	0.0268
Copper, Total	0.0308	0.0269	0.0308
Cyanide, Total	0.042	0.026	0.042
Fluoride By 300.0	42.1	59.3	59.3
Hardness, Total	20	17	20

TABLE B-21
EXCESS LIFETIME CANCER RISK: SURFACE WATER INGESTION
TRESPASSER SCENARIO
South Landfill Depression - Surface Water

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Surface Water Concentration (µg/L)	Excess Lifetime Cancer Risk	Percent of Total Risk
Beryllium	B2	4.30E+00	5.90E+00	9.22E-08	100.00
SUM OF RISKS				**9.2E-08**	

EXPOSURE ASSUMPTIONS		
Exposure Setting		Trespasser
Exposure Case		Reasonable Maximum
Water Intake (L/hour)	- Child	0.05
Body Weight (kg)	- Child	35
Number of Hours/Day Exposed		0.5
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Child	5
Averaging Time: Lifetime (yr)		70
Lifetime Average Water Intake (mg/kg body wt./day)		3.63E-06

TABLE B-22
EXCESS LIFETIME CANCER RISK:
DERMAL CONTACT WITH SURFACE WATER
South Landfill Depression - Surface Water

Chemical	EPA Carcinogen Classification	Cancer Slope Factor (kg-day/mg)	Skin Permeability Constant (cm/hr)	Surface Water Concentration (µg/L)	Excess Lifetime Cancer Risk	Percent of Total Risk
Beryllium	B2	4.30E+00	0.001	5.90E+00	5.90E-09	100
SUM OF RISKS					**5.9E-09**	

EXPOSURE ASSUMPTIONS			
Exposure Setting	Trespasser	Number of Years Exposed	5
Exposure Case	Reasonable Maximum	Averaging Time: Lifetime (yr)	70
Body Weight (kg)	35	Exposed Body Part(s)	Arms, Hands, Legs
Number of Days/Week Exposed	1	Exposed Skin Surface Area (cm^2)	3200
Number of Weeks/Year Exposed	26	Duration of Contact (hour/day)	0.5

TABLE B-23
NONCANCER HEALTH RISK EVALUATION: SURFACE WATER INGESTION
TRESPASSER SCENARIO
South Landfill Depression - Surface Water

Chemical	Reference Dose (RfD) mg/kg-day	Surface Water Concentration (µg/L)	Estimated Daily Intake (DI) (mg/kg-day)	Hazard Quotient (DI/RfD)	Exceed Reference Dose?	Percent of Total Risk
Aluminum	1.00E+00	6.26E+03	3.19E-04	3.19E-04	NO	0.6
Beryllium	5.00E-03	5.90E+00	3.00E-07	6.00E-05	NO	0.1
Copper	3.70E-02	2.68E+01	1.36E-06	3.69E-05	NO	0.1
Cyanide	2.00E-02	4.20E+01	2.14E-06	1.07E-04	NO	0.2
Fluoride By 300.0	6.00E-02	5.93E+04	3.02E-03	5.03E-02	NO	99.0
HAZARD INDEX (Sum of DI/RfD)				**0.051**		

EXPOSURE ASSUMPTIONS		
Exposure Setting		Trespasser
Exposure Case		Reasonable Maximum
Water Intake (L/hour)	- Child	0.05
Body Weight (kg)	- Child	35
Number of Hours/Day Exposed		0.5
Number of Days/Week Exposed		1
Number of Weeks/Year Exposed		26
Number of Years Exposed	- Child	5
Averaging Time: Lifetime (yr)		5
Lifetime Average Water Intake (mg/kg body wt./day)		0.00005

TABLE B-24 NONCARCINOGENIC HEALTH RISK EVALUATION: DERMAL CONTACT WITH SURFACE WATER South Landfill Depression - Surface Water							
Chemical	**Reference Dose (RfD) (mg/kg/day)**	**Skin Permeability Constant (cm/hr)**	**Surface Water Concentration (µg/L)**	**Estimated Daily Intake (DI) (mg/kg/day)**	**Hazard Quotient (DI/RfD)**	**Exceed Reference Dose ?**	**Percent of Total Risk**
Aluminum	1.000E+00	1.000E-03	6.260E+03	2.038E-05	2.038E-05	NO	0.6
Beryllium	5.000E-03	1.000E-03	5.900E+00	1.921E-08	3.843E-06	NO	0.1
Copper	3.700E-02	1.000E-03	2.680E+01	8.727E-08	2.359E-06	NO	0.1
Cyanide	2.000E-02	1.000E-03	4.200E+01	1.368E-07	6.838E-06	NO	0.2
Fluoride By 300.0	6.000E-02	1.000E-03	5.930E+04	1.931E-04	3.218E-03	NO	99.0
HAZARD INDEX (Sum of DI/RfD)					**0.0033**		

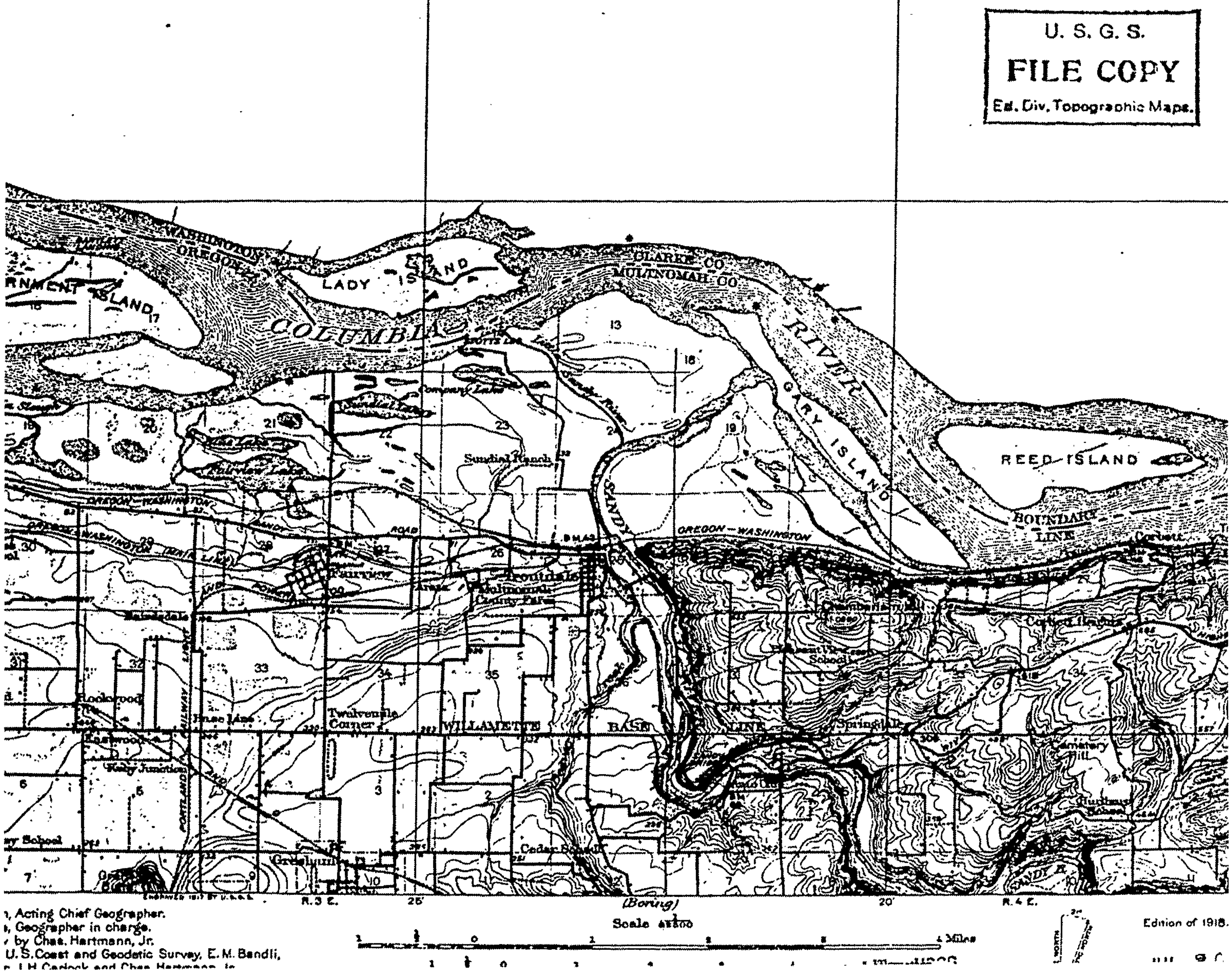
EXPOSURE ASSUMPTIONS			
Exposure Setting	Trespasser	Number of Years Exposed	5
Exposure Case	Reasonable Maximum	Averaging Time (yr)	5
Body Weight (kg)	35	Exposed Skin Surface Area (cm^2)	3200
Number of Days/Week Exposed	1	Time in Water (hour/day)	0.5
Number of Weeks/Year Exposed	26		

TABLE B-25 ECOLOGICAL SCREENING South Landfill Depression - Surface Water		
Chemical	**Ecological Screening Level (mg/L)**	**Surface Water Concentration (mg/L)**
Aluminum	7.64	6.3
Beryllium	4.97	0.0059
Copper	66.3	0.027
Cyanide, Total	40.4	0.042
Fluoride By 300.0	140	59

NOTES:
Shading indicates an exceedance of screening criteria.
No surface water concentrations exceeded screening levels.

Attachment C

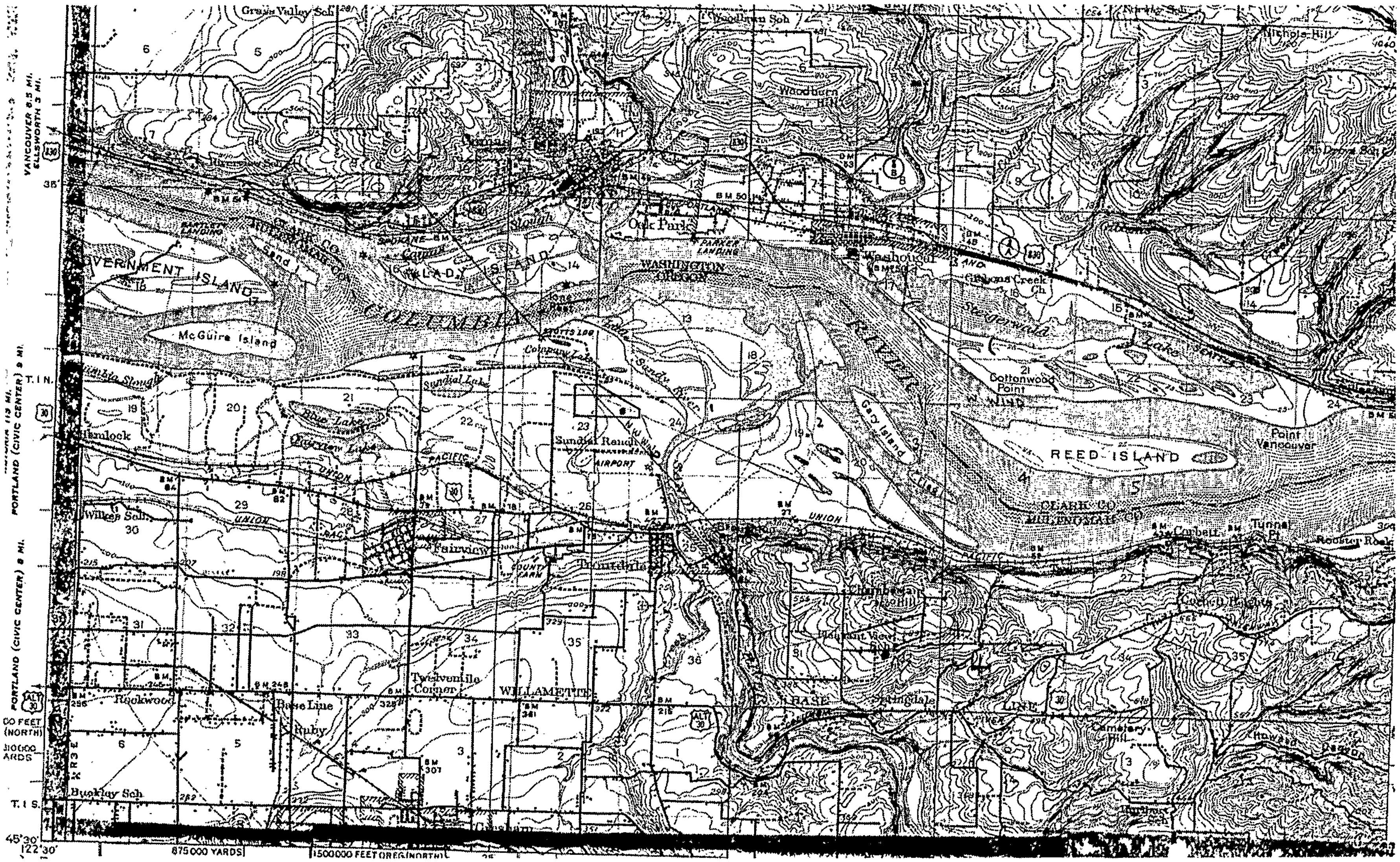
Historical USGS and NOAA Maps



Source: U.S. Geological Survey

U.S. Geological Survey Topographical Map
Troutdale Quadrangle
Dated July 30, 1918

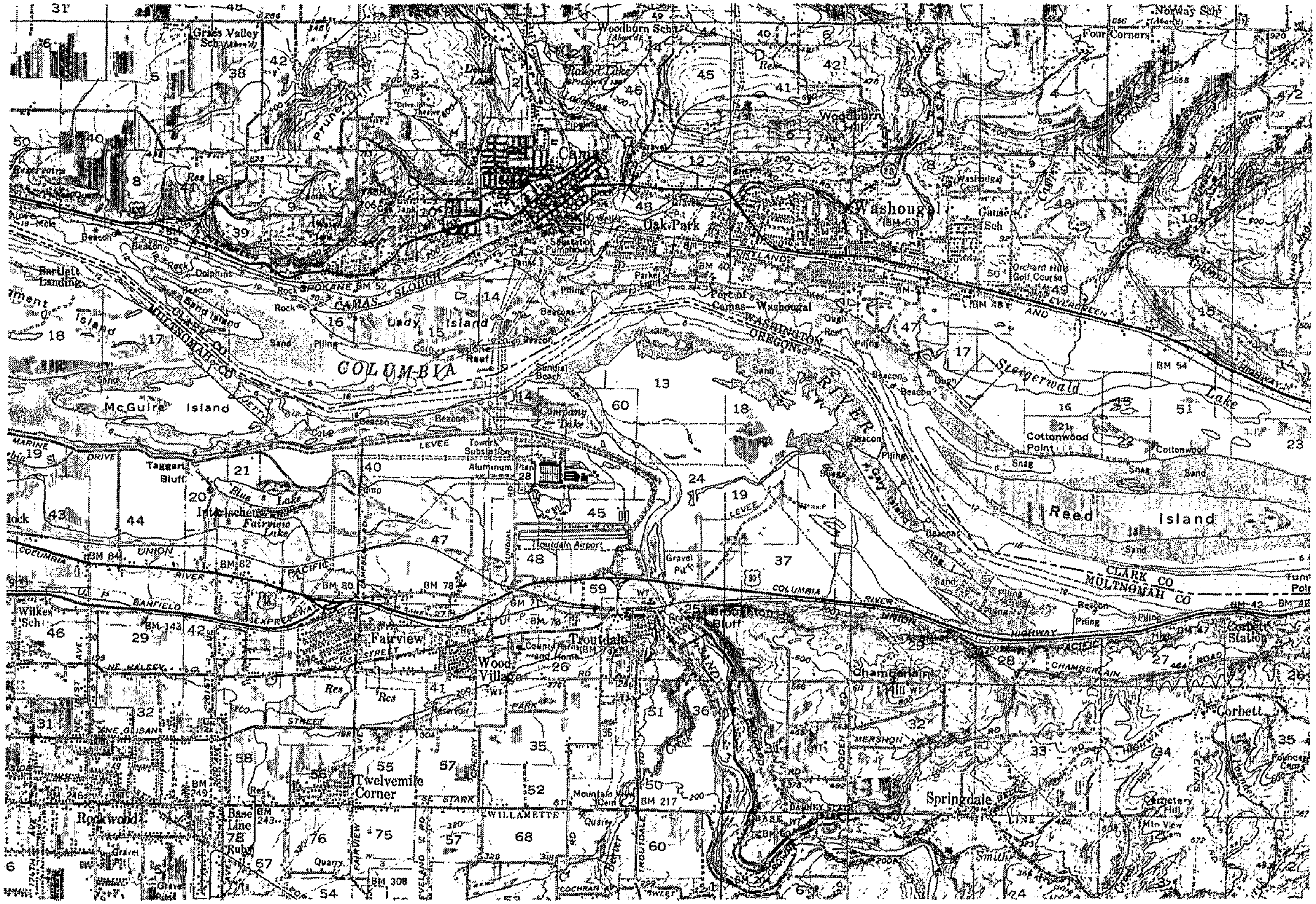
107493.S1.08 Map 1 Reynolds Report 12/08/97 ams/cvo



Source: U.S. Geological Survey

U.S. Geological Survey Topographical Map
Camas Quadrangle
Revised 1937

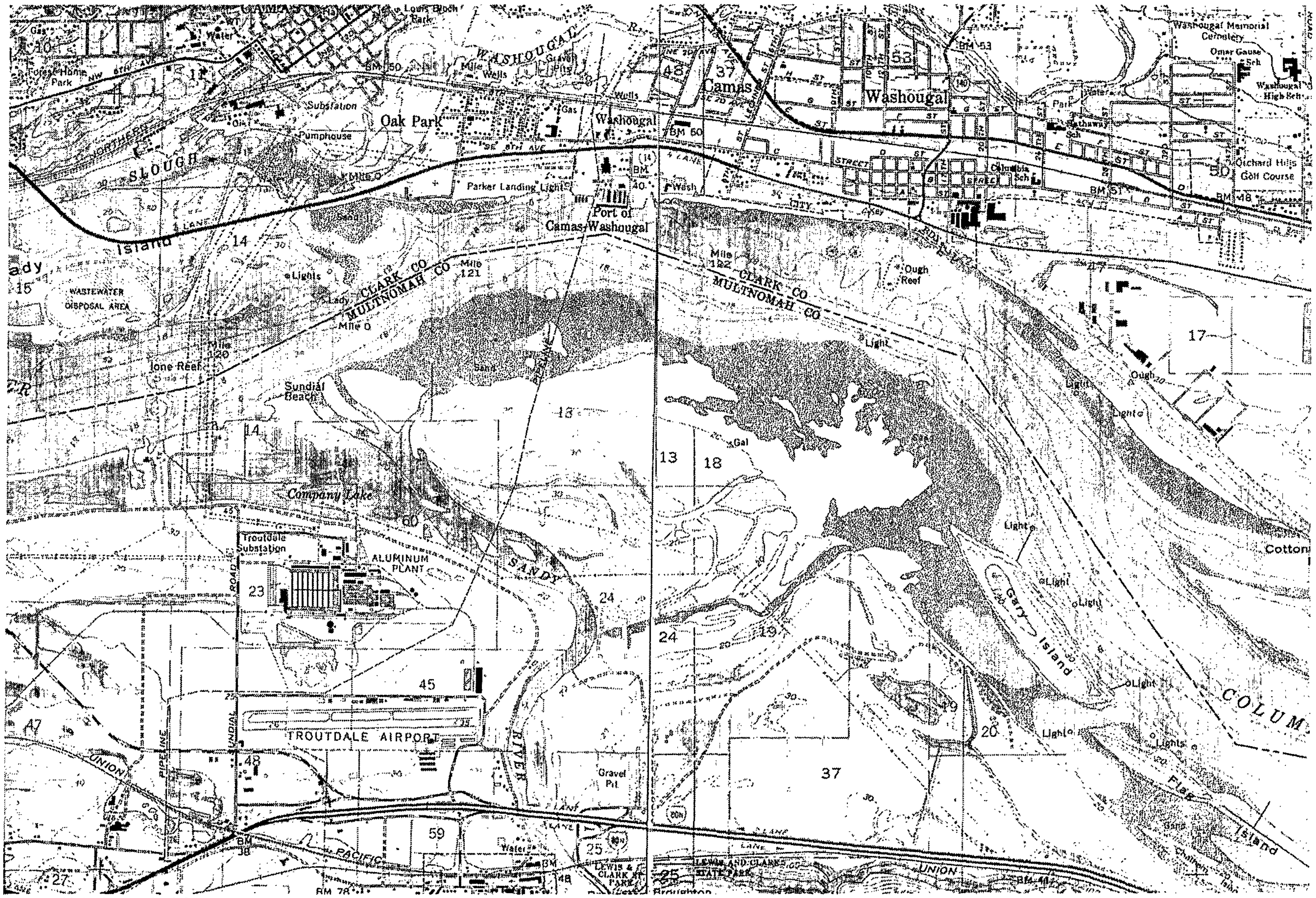
107493.S1.08 Map 2 Reynolds Report 12/08/97 ams/cvo



Source: U.S. Geological Survey

U.S. Geological Survey Topographical Map
Camas Quadrangle
Revised 1954

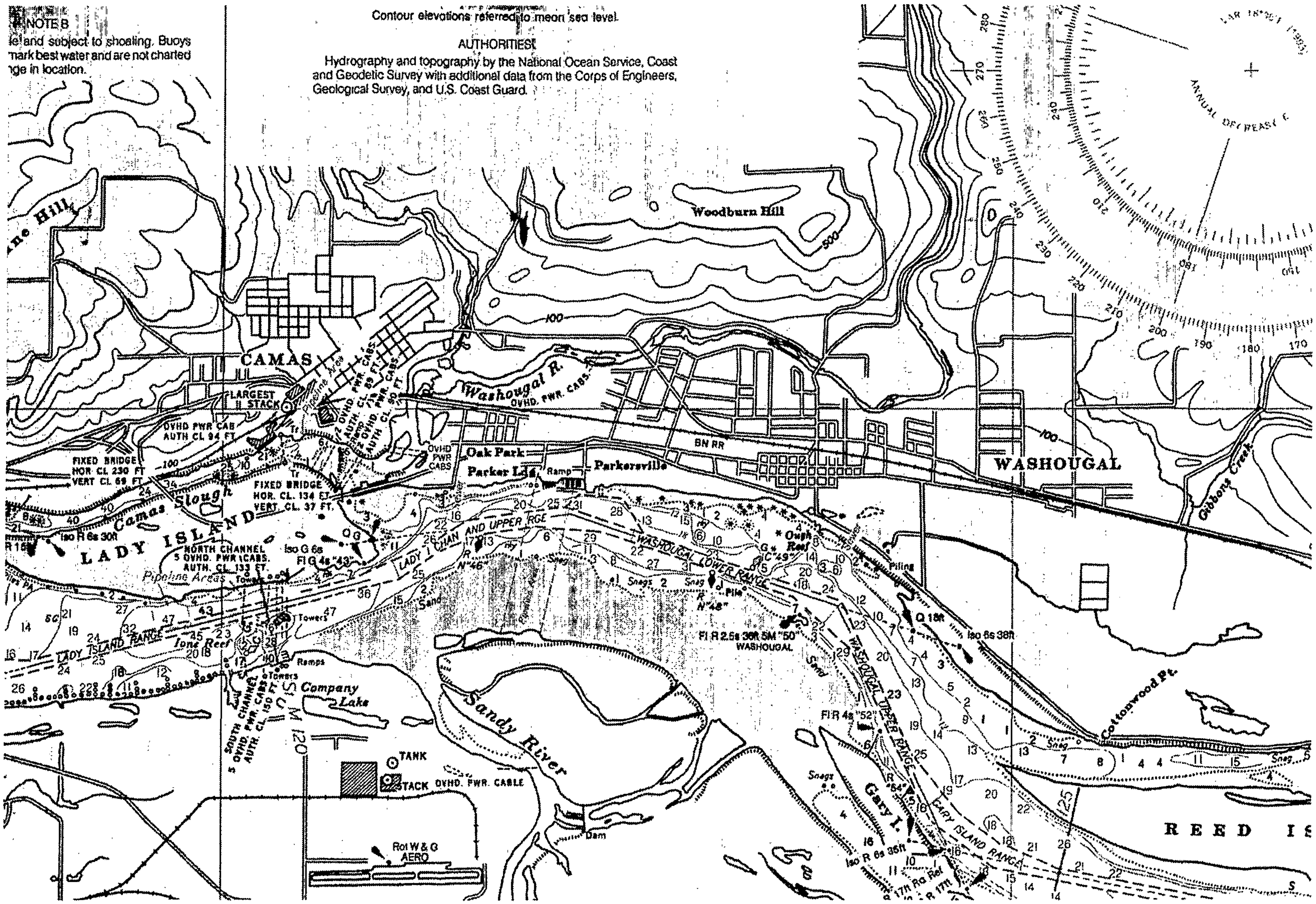
107493.S1.08 Map 3 Reynolds Report 12/08/97 ams/cvo



Source: U.S. Geological Survey

U.S. Geological Survey Topographical Map
Camas and Washougal Quadrangles
Revised 1975

107493.S1.08 Map 4 Reynolds Report 12/08/97 ams/cvo



National Oceanic and Atmospheric Administration
Nautical Map for the Columbia River (Vancouver to Bonneville)
February 1994
Nautical Chart Catalog No. 2, Panel G